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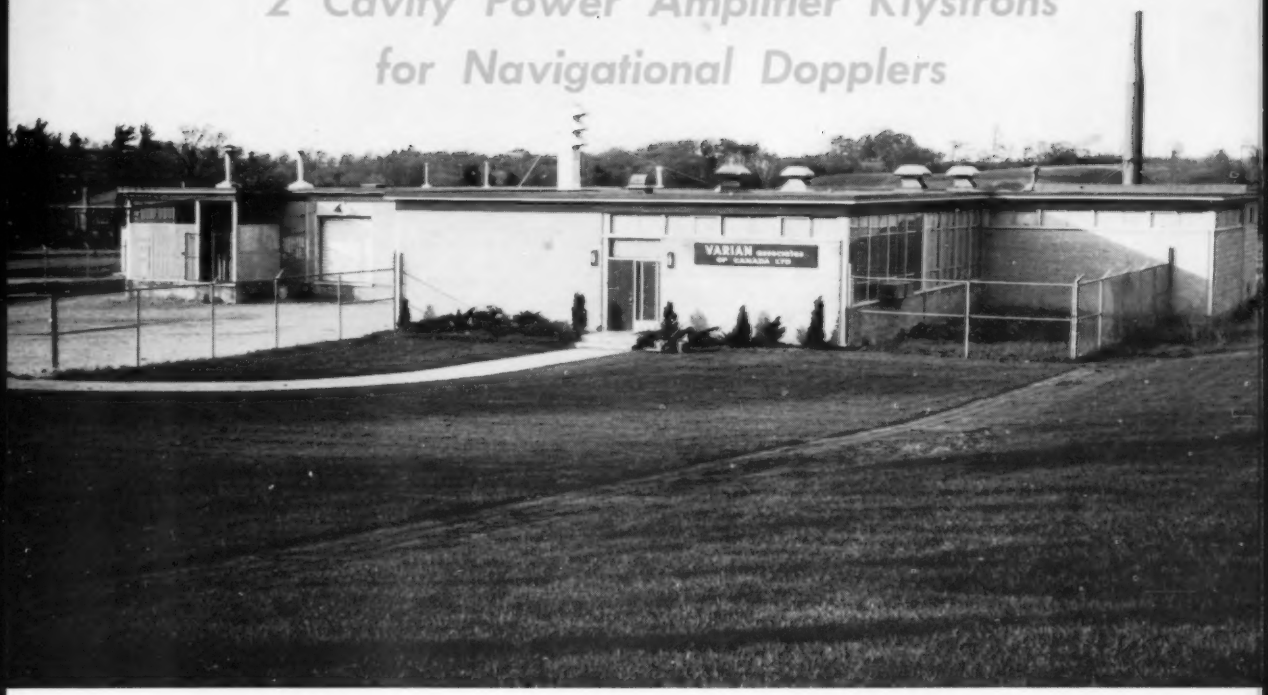
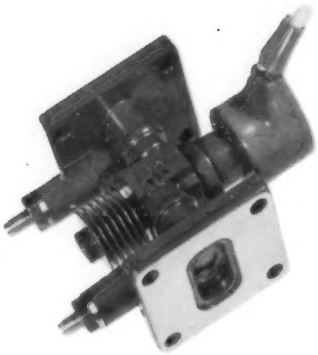


FREQUENCY	9.4 ± 10 kMc
POWER OUTPUT	3 watts
POWER INPUT	750 V — 60mA
LOW LEVEL GAIN	10 db
SATURATION GAIN	7 db
BANDWIDTH	5-10 mc/s



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October, 1959

CANADIAN ELECTRONICS ENGINEERING

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1959 IRE Canadian Convention & Exposition

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cover design

Art director Frank Davies recognized the close association between IRE and Canadian Electronics Engineering, and found an effective way to show it.

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contributors and special articles in this issue:

G. W. Holbrook (Continuous cro display simplifies amplifier distortion testing) was born in Asquith, Saskatchewan. He graduated from London University with the degree of B.Sc., then went on to receive his M.Sc. degree from Queen's University in 1949, and his Ph.D. degree from London University in 1956.

From 1939 until 1946, Dr. Holbrook served with the British Army, then served with the Canadian Army from 1946 until 1952 with the rank of Lieutenant-Colonel. Since 1952 he has been with the Royal Military College of Canada as head of the department of electrical engineering.

The subject of designing for environment in the upper atmosphere, as well as at lower altitudes, is becoming more and more complex. Equipment technology is advancing, and so is our knowledge of the natural environment up to very high altitudes. Two authors from the Canadian Military Electronics Standards Agency (CAMESA), **A. W. Harris and E. W. Parrott** (What's up there?) have reviewed the latest information available on natural environments up to heights of 1,000 km and prepared a good summary for design engineers.

Mr. Harris is a graduate in electrical engineering from McGill University. From 1944 to 1946 he was employed with the Department of Munitions and Supply, and National Research Council. From 1947 to date he has been with the RCAF and CAMESA. He is responsible for the testing and approval of electronic components and materials and their application in military equipment. He is a member of IES and the Association of Professional Engineers of Ontario.

Mr. Parrott is a graduate in electrical engineering from London University. He has spent eight years in the design of military test equipment and guided missiles at the Royal Aircraft Establishment, the Plessey Co. and Wayne Kerr in England. He is currently responsible for testing procedures, test equipment and the correlation of laboratories at CAMESA. He is a member of IES, Association of Professional Engineers of Ontario, and IEE.

The 1959 IRE Canadian Convention and Exposition is going to present a well balanced program of technical papers, plus many displays of new equipment, components and developments. If a central theme can be ascribed to the event, it is quality.

Once more, the editors of CEE have been working very closely with members of the Convention staff, authors and exhibitors to gather preconvention information for this issue. Study it carefully and you will be able to plan your trip to the convention for most effective use of available time. Information is given on technical papers, exhibits, new products being displayed, and special functions taking place during the convention. A new feature this year in CEE is photographs of authors.

Nucleonic news, the bi-monthly news page devoted to events from the nuclear energy field having particular interest for electronics engineers, is moving one step to the right. The next issue will appear in November, then every second month after that. In this way it will be able to bring more timely information to you relative to events scheduled for the coming year.

Holbrook

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NEWS HIGHLIGHTS

Ferranti-Packard Electric Ltd., Toronto, has been awarded a contract to design and manufacture a large digital computer for Trans-Canada Air Lines' nationwide reservation system.

TCA has followed a "buy Canada" policy—with good reason. It has engaged one of North America's foremost groups of computer engineers to design the general purpose digital computer for its 3½-million-dollar reservation system. The same engineers at Ferranti-Packard Electric Ltd. have already designed the transactors, the small units used to link reservation desks with the central control point. TCA presently handles 3,500,000 transactions in flying 250,000 passengers per month. The electronic reservation system will reduce human transactions by 60%. In addition, the system will handle enquiries in approximately two seconds.

British Commonwealth astronautical societies met in London last month to discuss possibility of Commonwealth nations undertaking joint program of space research. Canada was absent.

Space research is fantastically expensive. Only two nations, U. S. A. and U. S. S. R., have full-scale programs, and they strain the national budgets. One solution for smaller nations is to pool resources. Last year A. E. Maine, a founder of the Canadian Astronautical Society, proposed that members of the British Commonwealth meet to discuss a joint research project. Such a meeting was held in London last month—but Canada was not fully represented; the Canadian Government failed to send a delegtae to this important meeting. If Canada is to be a nation, and not a pawn, our government must stop its aimless meandering and take a constructive lead with well-defined policies in many fields, including research.

Watch for signs of a sudden move to stereo broadcasting. Sharp increase in sales of fm receivers may spark broadcaster interest.

Latest statistics released by EIA show distributor sales of receivers with fm facility at 9,445 for the first seven months of 1959. At the same time last year the total was only 1,449. This sharp increase shows that Canadian listeners are interested in good quality music and reproduction—when they can get it. Broadcasters have been slow in recognizing this fact, but there are many signs of better programing for the future. One trend that could grow rapidly is in the field of stereo broadcasting. Stumbling block at the moment, however, is any universal standard on the method used to transmit the signals. Because of its superior quality, some form of fm is likely. New techniques will be discussed at the IRE Canadian Convention this month.

Canadian Oil Companies Ltd., Toronto, is going to install a Farrington character-sensing machine as part of its credit card billing system.

The first Canadian installation of Scandex, the Farrington Manufacturing Company's character-reading machine, will be made in January, 1960. The machine will be used by Canadian Oil Companies Ltd. to read account numbers on customer invoices, translate what has been read into electrical signals, then convert the invoices into punched cards for future automatic data processing. It will operate at the rate of 180 cards a minute.

Canadian Pacific Airlines has ordered Edo Loran navigation systems for its jet-prop Bristol Britannias operating on the Canadian Empress routes.

Loran is a lightweight (29 lb) system wtih direct-reading cockpit display which enables the pilot to obtain a two- or three-line position fix in a matter of seconds. It will be used on the Canada to Europe, and Canada to Hawaii and Far East routes of CPA. Sixteen other international air carriers have installed or ordered the same type of equipment for their jet, turbo-prop and jet-prop fleets.

Canadian motion picture companies are going electronic. At least two have installed video tape recording facilities.

When tv first began to replace the neighborhood theatre it provided Canada's small movie industry with an opportunity. Producing short movies for tv was economically possible for small companies, and several have been able to make a go of it in Canada within the past few years. The tv stations switching over to video tape recording, the motion picture companies are having to do likewise. Robert Lawrence Productions (Canada) Ltd. has just opened a $750,000 film and Videotape centre in Toronto. Meridian Films has invested about $350,000 in electronic equipment for a Videotape production studio. Current estimate for a 100-ft-by-100-ft sound stage with equipment, adjoining workshops, administrative wing, dressing rooms, etc., is about $200,000.

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Lake Engineering Company appoints Taylor sales manager

Lake Engineering Company Limited has promoted **Frank P. Taylor** to the position of sales manager.

Mr. Taylor joined his present company in 1956, after sales and purchasing experience in the Canadian electronics industry. He previously held positions with Northern Electric Company Limited and National Fibre Company Limited. In his new position he will have broad responsibility for the company's component sales to equipment manufacturers.

Taylor

Labey

Johnston

Northern chooses Labey for Toronto

Appointed sales manager of the Toronto region for Northern Electric Company is **Frank P. Labey.**

Born in Stonewall, Manitoba, Mr. Labey graduated from the University of Manitoba in 1934 with a B.Sc. degree in electrical engineering. Five years' experience was gained with electrical companies in England, following which he joined Northern Electric in Montreal as illumination assistant in the general sales department. He was appointed illumination manager in 1948 and remained in this capacity until 1954 when he was appointed wiring materials manager. A year later he was promoted to wiring materials marketing manager and, in 1957, supply manager.

Mr. Labey is a member of the Electrical Club of Montreal, the Canadian Electrical Association and the Engineering Institute of Canada.

New vice-president for Clairtone

Clairtone Sound Corporation Limited have announced the appointment of **Wallace R. Johnston** to be vice-president, in charge of sales.

Mr. Johnston has been associated with the electronics industry in Canada for 23 years. He started his career with Anthony Foster and Sons Limited, serving in all sales capacities. He then moved to Canadian Admiral Corporation where he acted as Montreal branch manager, later becoming regional manager for all Canada, except Ontario. He joined Zenith Radio Corporation of Canada first working in the Western Provinces and later establishing the dealer organization for that company in East Toronto and Northern Ontario.

Memory unit designer moves west

The man responsible for the design of a Coincident Current Magnetic Core Memory, **R. S. C. Cobbold,** has accepted an appointment at the Department of Electrical Engineering, University of Saskatchewan. He will take up his new position on October 1.

Mr. Cobbold, an Englishman, graduated from London University in 1956 with a B.Sc. in physics. Previously he had been employed as an assistant experimental officer at the Atomic Weapons Establishment. He joined the Defence Research Board of Canada in 1956 working in the Electronics Laboratory of the Telecommunications Establishment.

It was Mr. Cobbold's work with the Telecommunications Establishment that resulted in the development of the Magnetic Core Memory.

RCA engineer now manager

An engineer of the RCA Victor Company Limited has been promoted to manager of record engineering at the RCA Smiths Falls plant. He is **Mark A. Badior.**

Mr. Badior joined RCA in 1954 after receiving his M.Sc. He is a graduate of both Carleton and McGill Universities. In his new position he will be responsible for all manufacturing engineering functions at the plant, including chemical analysis and control of manufactured products.

Union Carbide appointments

F. Perry Wilson has been elected to the newly created office of executive vice-president, Union Carbide Canada Ltd. A graduate in chemical engineering, Mr. Wilson was appointed vice-president of the company in 1956, and elected a director in 1958.

J. C. McDonald has been appointed manager, market research and technical services, Bakelite Company, Division of Union Carbide Canada Ltd.

W. L. Canniff has been appointed manager, development, in the same company.

Sola announce a trio

Three sales appointments are announced by Sola Electric (Canada) Limited.

Guy V. Fortier becomes sales representative for the Maritimes, the province of Quebec and the city of Ottawa. Mr. Fortier is a graduate of Columbia University and has six years' experience in the electronics industry.

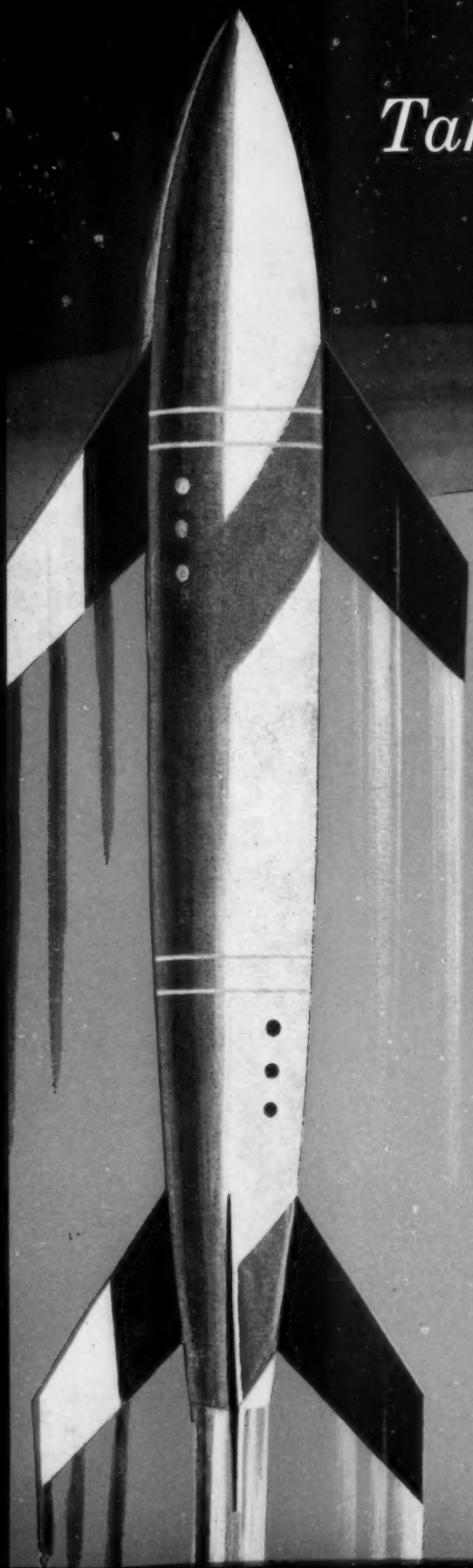
The new representative for the province of Ontario, except Ottawa, is **James W. Roe.** He is a graduate of the Ryerson Institute of Technology and since graduation has been active in the field of specialty transformers.

Fortier

Ligertwood

Roe

Douglas A. Ligertwood has been appointed to represent the company in Manitoba and Saskatchewan with headquarters in Winnipeg. Mr. Ligertwood has over ten years' experience in the sales and service of specialty transformers.



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ACTUAL SIZE OF THE NEW

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Bendix has developed a "Pygmy" line of miniature electrical connectors that do the work of standard AN connectors one-third the standard weight and size. These mighty midgets combine the outstanding qualities that have made Bendix connectors a by-word in advanced electronic equipment—ruggedness, reliability, serviceability. Bendix "Pygmy" connectors—like all Bendix connectors—are also outstandingly resistant to vibration, moisture and corrosion.

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Northern Electric Co. installs acoustic anechoic chamber

Latest research facility of Northern Electric Co. Ltd. is the new acoustic anechoic chamber it has installed at its Belleville, Ont., laboratories to measure performance of electroacoustic devices.

Outside shell of the chamber floats on 16 rubber pads that are two inches thick. The floor is essentially an eight-inch deep box filled with sand that rests on a three-inch mat of fiberglas. Reduction of sound intensity is in the ratio of approximately 100,000 to 1, or 50 db. To reduce airborne vibrations, the walls and ceiling are provided with sufficient mass. At the same time, vibrations that are solid borne are reduced by floating the entire enclosure.

Reduction of sound reflections from the inside surfaces is accomplished by lining the surfaces with long Fiberglas wedges that, combined with an air space between them, absorb most of the sound energy. Sound reflection is further reduced by constructing the walking surface of expanded metal grating having a high percentage of open area.

Test equipment associated with the chamber is capable of automatically recording the sound pressure produced by a loudspeaker or the voltage produced by a microphone at any frequency from 20 cps to 20,000 cps. Complete response can be measured and recorded in less than a minute. The chamber is also claimed to assist in psychoacoustic testing.

One of the immediate applications of the acoustic anechoic chamber is for the performance measurements of Northern Electric's stereophonic microphone which features a double cardioid pattern for 180 deg spatial effect.

Canadian atomic clock is accurate timepiece

An atomic timepiece controlled by electronic equipment and accurate within a few billionths of a second has been developed and put into operation by the National Research Council. It is the second of its kind in the Western world — the other is in England — and is expected to play a valuable role in space and nuclear research as well as in industrial and military applications where precise timing is a necessity.

The clock, similar to one at the National Physical Laboratory in England, was built at NRC's division of applied physics under the direction of Dr. S. N. Kalra, 32-year-old head of the division's high frequency laboratory. A native of India who has been with NRC since 1952, Dr. Kalra started work on the clock in 1956. Associated with him in this research are Ralph Bailey, 47, formerly of Eyebrow, Sask., and Herman Daams, 42, native of Holland and NRC staff member for two and a half years.

The clock itself does not tell the time directly, but works in conjunction with a crystal clock, controlling the radio frequencies of quartz crystals. By doing this the system tells time with an accuracy of within one second in 300 years.

Company to manufacture new rectifier products

International Rectifier of Canada is completing plans to manufacture selenium and silicon rectifier stacks, including battery charging rectifier stacks and television replacement units. The company intends eventually to produce a broad range of rectifier products employing selenium, silicon and germanium for rectifying devices and silicon and selenium for solar cells and self generating photocells.

CNR buys railroad radios to improve communications

The Canadian National Railway has purchased 72 Bendix locomotive radio sets and 45-way station equipments from Computing Devices of Canada Ltd. for use on the Edmonton-Vancouver portion of the CNR transcontinental line.

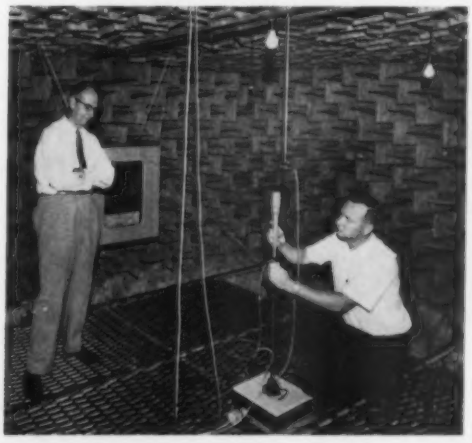
Part of an extensive radio communications system to increase the efficiency of train operations, the installation will simplify contact between dispatchers and train crews by providing end-to-end, train-to-train and train - to - wayside communications. Slated for completion in 1960, the radio system will supplement the present line telephone communications system between despatchers and operators.

Overseas Telecommunications Corp. has profitable year

Since coming into being in 1950, the Canadian Overseas Telecommunication has had nine successive years of profitable operation. The annual report just tabled in the House of Commons revealed that the Corporation had a net profit of $625,703 after provision for income tax of $565,426 and $446,206 for interest charges on government loans.

The report also listed some of the Corporation's future projects. A new Canada-United Kingdom multichannel cable, scheduled for completion in 1961 and forming the first leg of the proposed British Commonwealth "round the world" all purpose cable, is receiving top priority.

Arrangements have been concluded between COTC and the Great Northern Telegraph Co. of Denmark for a telephone cable linking Newfoundland, Greenland and Iceland. Ultimate connection will be made with the United Kingdom. This system, set for completion in 1962, will provide the rapid and stable telecommunications facilities required by the International Civil Aviation Organization to meet the demands of the jet age of aviation. promising sales campaign for the company's full line of closed-circuit television equipment. The areas: apparatus department and electronic equipment and tube department. A number of industrial tv installations have already resulted from this co-operation, according to the company.



R. H. Tanner, left, and A. Jamroz prepare to test a stereo microphone in Canada's first commercial acoustic anechoic chamber recently completed by the Northern Electric Co. Ltd. at Belleville, Ont.

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permit instant room-to-room intercommunication between key personnel independent of the normal office telephone system. Siemens intercom systems are noted for their outstanding fidelity of rendition, secured through the use of resonance-free housings, high-grade microphone-loudspeakers with a bass delay element and a broad frequency band, and special-type amplifiers with built-in degeneration.

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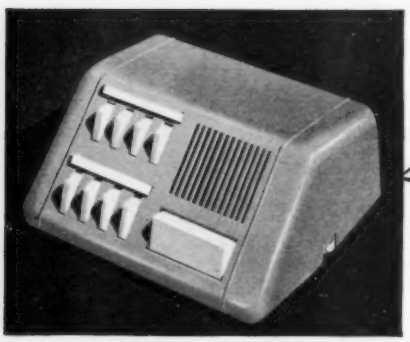
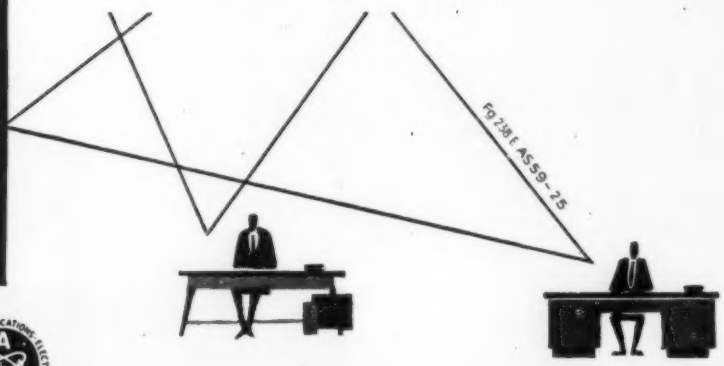
Each station is equipped with a microphone-loudspeaker console and an amplifier box; the amount of equipment used is adaptable to the particular requirements of your organization.





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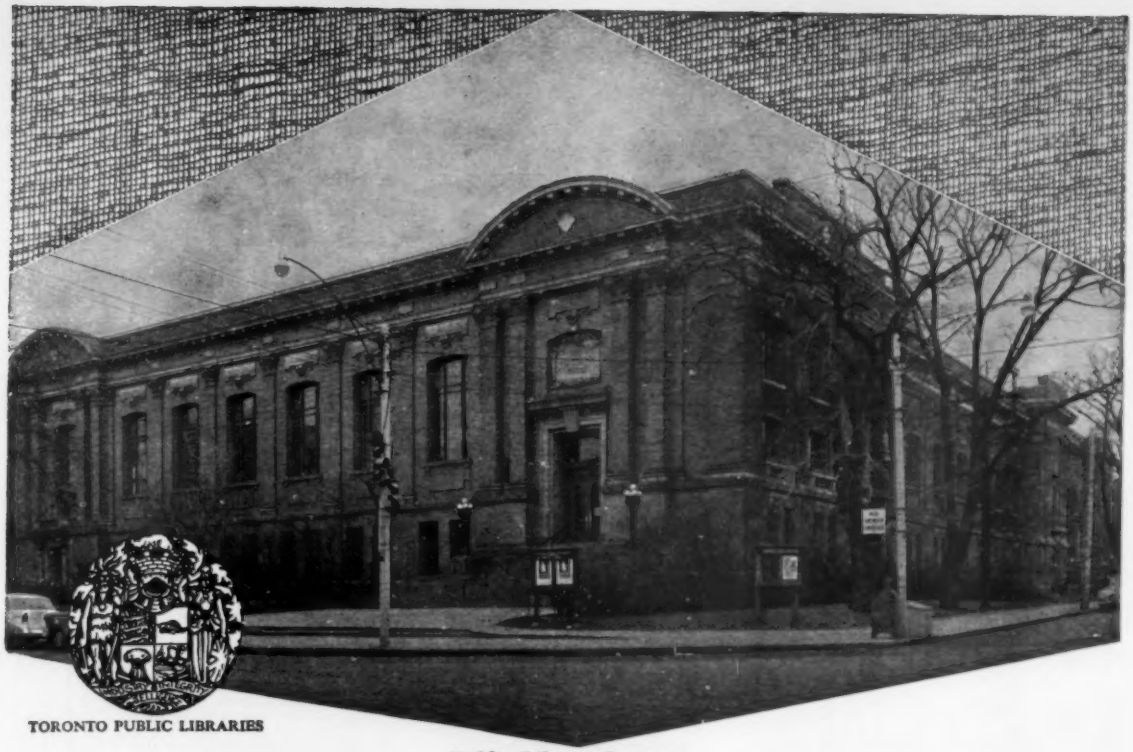

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The McGill University Library School Documentation Seminar 1958 stated: "The pre-eminent position given to business publications has long been recognized . . . libraries have for many years devoted attention to providing the widest access to business publications".

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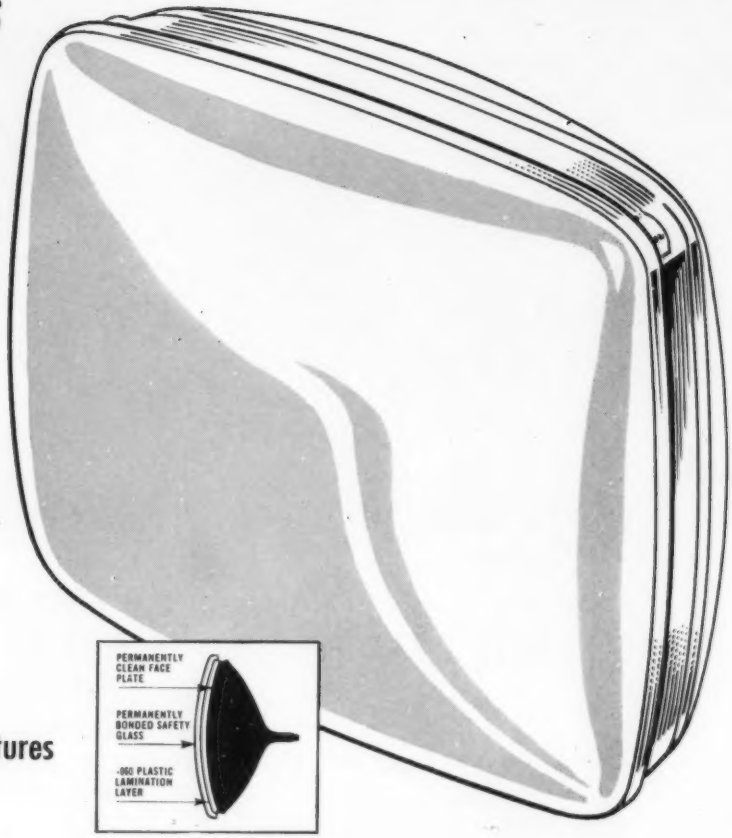

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Receiving & TV Picture Tubes • Power Tubes
Magnetrons • Klystrons • Image Orthicons
Carcinatrons • Thyratrons • Travelling Wave Tubes
Rectifier Tubes • Clarostat Controls and Resistors
National Communications Receivers and Components

ELECTRONIC TUBE AND COMPONENTS DIVISION

CANADIAN **Marconi** COMPANY

830 BAYVIEW AVENUE, TORONTO, ONTARIO

Branches: Vancouver • Winnipeg • Montreal • Halifax • St. John's, Nfld.

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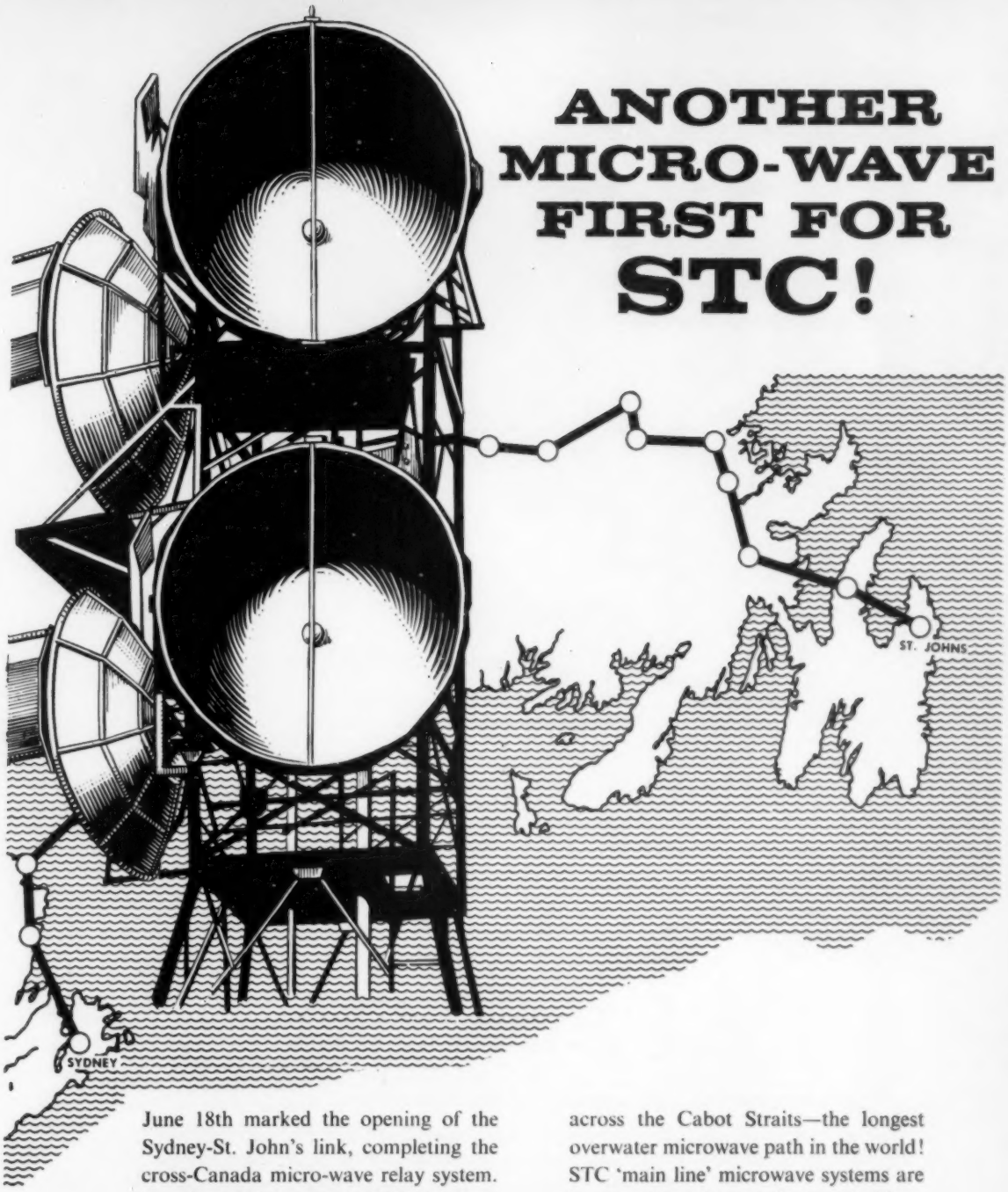

ANOTHER MICRO-WAVE FIRST FOR STC!

June 18th marked the opening of the Sydney-St. John's link, completing the cross-Canada micro-wave relay system. Standard Telephones & Cables' inventions and techniques made possible the successful spanning of the 69-mile hop across the Cabot Straits—the longest overwater microwave path in the world! STC 'main line' microwave systems are in operation all over the world. There are now over 1000 route miles in Canada!

Standard Telephones and Cables Mfg. Co. (Canada) Ltd.

9600 St. Lawrence Blvd., Montreal 12, Que.

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AMONG THE FOREMOST IN WORLD COMMUNICATIONS

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CHECK CLM for ... electrical components and equipment

- **SELENIUM RECTIFIER CELLS**—High current density (HCD) power types. Using special Vacuum process producing a cell having low losses and high efficiency.
- **SELENIUM RECTIFIERS**—Complete units operating on AC and producing various devised DC ratings. Units designed in all types of cabinets—relay rack mounting, wall mounting, floor cabinets and cubicles.
- **REGULATED SELENIUM RECTIFIERS**—Using specially designed transistorized regulating circuit to maintain DC voltage within ±1% from 5% to full load with line voltage variations of ±10%. These DC power plants are designed in many ratings from a few watts to several Kilowatts.
- **SELENIUM BATTERY CHARGERS**—Several types are available—manually operated, constant voltage regulated, filtered for talking circuits. Hi-Lo substation battery types.
- **SELENIUM BATTERY ELIMINATORS**—DC power supplies for small telephone exchanges suitably filtered and regulated for constant voltage.
- **TAPE RELAY CABINETS**—Special classified teleprinter type cabinets designed in conjunction with Engineers of Canadian Government.
- **TAPE WINDERS AND REELS**—Ruggedly designed to meet requirements of Military Teleprinter service.
- **TWO WAY AMPLIFIERS**—For Air Terminal use specially designed in conjunction with engineers of Canadian Government Department of Transport.
- **AIRPORT LIGHTING CONTROL**—Relay equipment in rugged outdoor cabinets for remote control of runway strips.
- **WATER HEATER CONTROL**—Carrier current control systems for removing water heaters and other off-peak loads from power systems reducing the peak demand on the system. Also controls street-lighting.
- **HIPOT COUPLERS**—For synchronizing and voltage indication as well as voltage charge alarm on Power systems.
- **HIPOT PHASING STICKS**—A simple, fast and safe method of phasing, phase rotation and determining whether line alive or dead on power systems.
- **RELAYS**—Various types and sizes of telephone relays both standard and plug-in, as well as small power type relays.

For more complete information, write or contact: Mr. Jack West, P. Eng., Product Manager, Rectronic Division, Canadian Line Materials, Toronto 13, Canada.

CLM

CANADIAN LINE MATERIALS

Toronto 13, Canada

DIVISION OF McGRAW-EDISON COMPANY (CANADA) LIMITED

McGRAW EDISON

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Now Made In Canada...

G-E 6600 SERIES TUBES

the low-cost answer for tough communication

Canadian General Electric now manufactures 6600 series tubes, specially designed for mobile communications equipment. In applications where shock, vibration, voltage fluctuations and other factors make standard tube operation unreliable, G-E 6600 Series Tubes are your most economical answer.

Here's why . . .

Higher Stability: *Every* tube lot is operated for the minimum period required to assure stable performance.

Tougher Heaters: With a tolerance of — 20% instead of the usual — 10% to accommodate wider voltage fluctuations.

Lower Voltage Operation: Every lot tested for major electrical characteristics at 5.0 volts on the heater instead of the usual 5.5 volts.

Full Interchangeability: With standard prototype tubes.

Canadian manufacture of G-E 6600 Series Tubes means lower cost to you. For full details and new prices, contact your nearest C-G-E Sales Office or authorized G-E tube distributor.

COMPARISON CHART:

TUBE TYPE	6660	6661	6662	6663	6669	6677	6678	6679	6680	6681
PROTOTYPE	6BA6	6BH6	6BJ6	6AL5	6AQ5	6CL6	6U8A	12AT7	12AU7	12AX7

GENERAL ELECTRIC
INDUSTRIAL & MILITARY
TUBES

Electronic Tube Section

1683-259

CANADIAN GENERAL ELECTRIC COMPANY LIMITED

For further information mark No. 25 on Readers' Service Card

class of
'52, '53, '54,
'55, '56, '57, '58

LITTON INDUSTRIES TORONTO INTERVIEWS

for positions in Southern California

Engineers · Scientists · Mathematicians

Attending IRE Canadian Convention, Toronto, Oct. 7-9

If you are experienced in airborne electronic systems and enjoy seeing your ideas turn into products, you may qualify for positions of major responsibility with Litton Industries in any of several convenient locations in the Los Angeles area. You will work with a company that is noted for developing, producing, and delivering advanced hardware of exceptional quality.

INERTIAL GUIDANCE AND CONTROLS

SYSTEMS DEVELOPMENT—Preliminary analysis through prototype development of highly advanced inertial navigation systems for manned and unmanned aircraft applications.

CIRCUIT DESIGN—Preliminary analysis, design, and development of transistorized circuitry pertaining to servo systems and advanced precision analog computers.

ELECTROMECHANICAL DESIGN—Packaging of subminiature components to include layout of etched cards and precision gear trains, sheet metal design and fabrication, and potting and encapsulation techniques.

PROCESSES AND PROCEDURES—Establish advanced engineering techniques for the production of precision gyros, accelerometers, and gimbal systems for stable platform applications.

AIRBORNE TACTICAL DATA SYSTEMS COMPUTERS AND CONTROL SYSTEMS

CIRCUIT DESIGN—Digital and analog computers and associated input-output devices.

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OPERATIONAL AMPLIFIER—Design and development of transistorized amplifiers for display systems.

SWITCHING CIRCUITS—Central computer and digital display circuits using core storage, capacitor storage, and semiconductors.

ANALOG-DIGITAL CONVERSION EQUIPMENT—Digital-shaft position, digital-DC, shaft position-digital, DC-digital.

SYSTEM CHECKOUT—Test, modification, and evaluation of development of prototype models of complex digital data processing and display systems for carrier-based and airborne use.

Initial assignments are available in both military and non-military projects, but applicants must be capable of obtaining U.S. security clearance to qualify them for future work. Numerous benefits include financial aid in continuing evening courses at first rate universities; excellent insurance program; financial assistance with relocation expenses.

To arrange for an interview with members of our Engineering Staff call Mr. Colby Ross at the Westbury Hotel, Toronto, WAlnut 4-0611, October 7 to 9.

LITTON INDUSTRIES Electronic Equipments Div.
Beverly Hills, California

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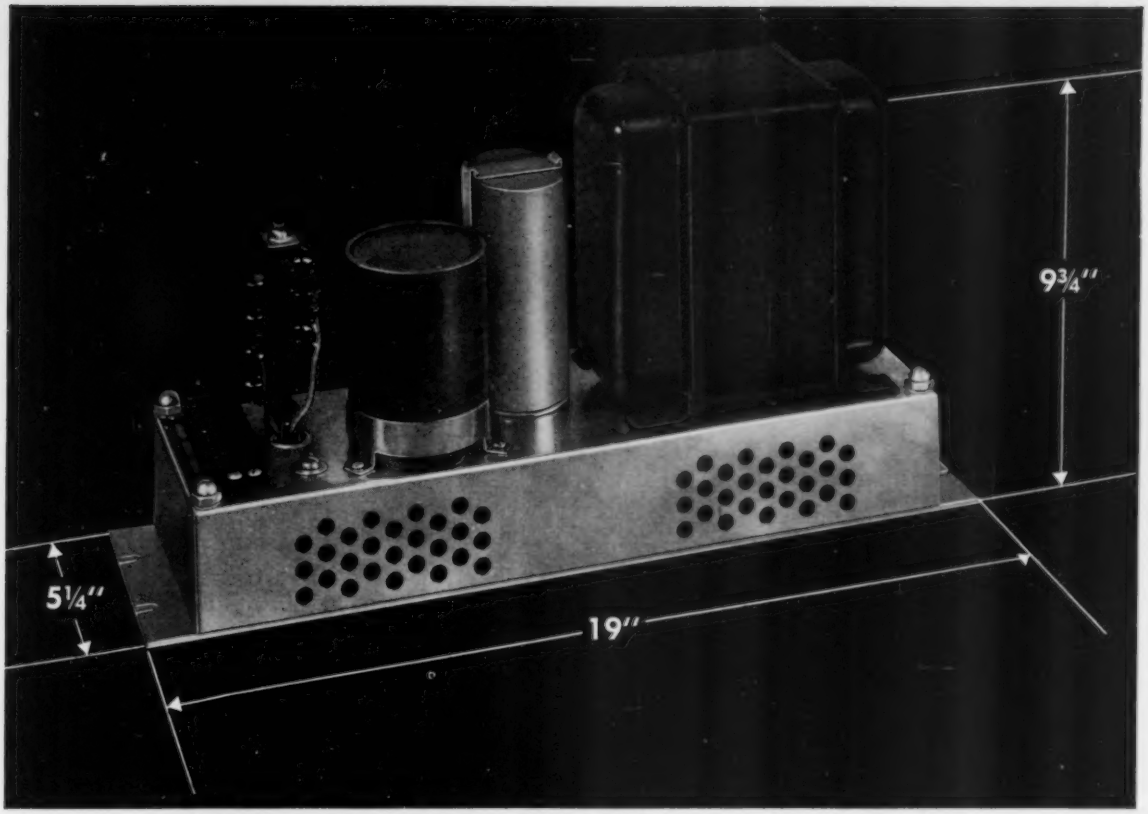


Sola Constant Voltage DC Power Supplies are designed for intermittent, variable, pulse or high-amperage loads.

Sola packs 6 amps of 300-watt regulated dc power into 5¼ inches of relay-rack space

Looking for a source of regulated dc power that fits into a small space? You'll probably find that the Sola Constant Voltage DC Power Supply offers what you want.

This compact unit has exceptional performance characteristics, too — it delivers current in the "ampere range," regulates within ±1% even under a ±10% variation in line voltage, has less than 1% rms ripple, and even tolerates dead shorts. It is 80% efficient and has a very low static output impedance.

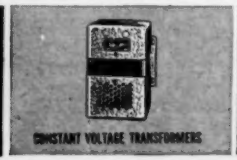
How's it done? Sola managed it through a balanced assembly of three complementary components . . . a special Sola Constant Voltage Transformer is teamed up with a semiconductor rectifier and a high-capacitance filter. Electrical characteristics of the transformer maximize most of the advantages of the rectifier and filter, while virtually eliminating all their disadvantages. The resulting regulated dc power supply is simple, highly reliable, compact and moderately priced.

These benefits are exhibited by the entire line of Sola dc power supplies. Sola has designed and produced hundreds of ratings to meet requirements of equipment manufacturers. The company is set up to handle specific needs for custom-designed units in production quantities. A Sola sales engineer can supply all the facts. In addition to this custom service, Sola currently stocks six models ranging from 24 volts at six amps to 250 volts at one amp.

For complete data write for Bulletin CV-235.

SOLA ELECTRIC (CANADA) LTD., 24 Canmotor Avenue • Toronto 18, Ontario • Phone: CLifford 1-1147
In The United States, Sola Electric Co., Chicago 50, Illinois, A Division of Basic Products Corporation

SOLA


CONSTANT VOLTAGE TRANSFORMERS

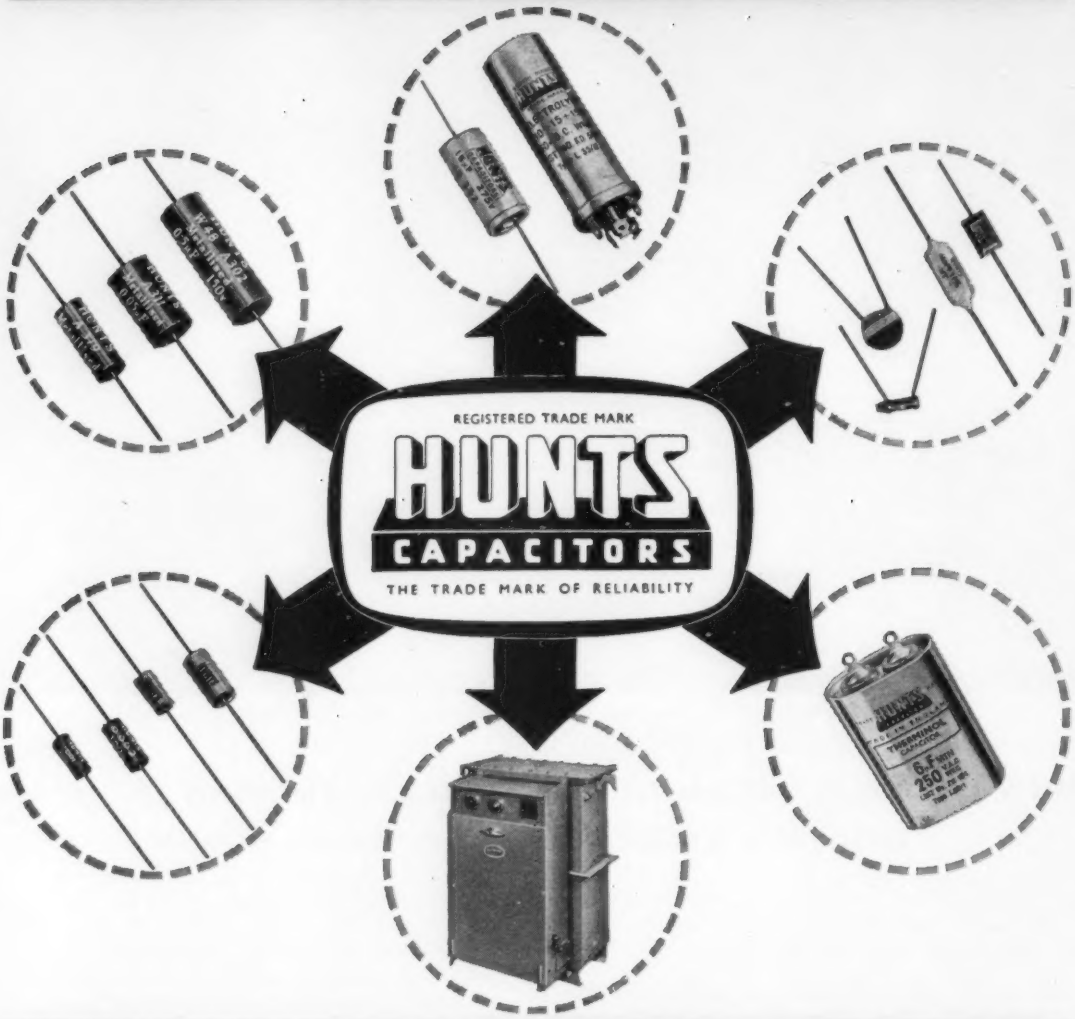
REGULATED DC POWER SUPPLIES

MERCURY LAMP TRANSFORMERS

FLUORESCENT LAMP BALLASTS

For further information mark No. 74 on our Readers' Service Card

CAPACITORS



for all applications

TYPES

DRY ELECTROLYTIC · METALLISED PAPER (HUNTS PATENTS)
METALLISED PLASTIC FILM (HUNTS PATENTS)
PLASTIC FILM · FOIL & PAPER · SILVERED MICA
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TRANSMITTING AND SPECIAL R.F. TYPES

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FLUORESCENT LIGHTING · PHASE SPLITTING
H.F. AND R.F. HEATING · IGNITION AND INTERFERENCE SUPPRESSION
TELEPHONE INSTALLATIONS

A. H. HUNT (Capacitors) LTD., WANDSWORTH, LONDON, S.W.18. Tel: VANdyke 6454

Factories also in Essex, Surrey and N. Wales.

AND IN CANADA: ADAMS ENGINEERING LTD., OTTAWA ONT., MONTREAL QUE., TORONTO ONT.

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VIBRATION RESISTANT
MOISTURE RESISTANT

Completely interchangeable

New miniature connectors for avionic equipment meet MIL-C-26482 (ASG)

Actual size photo shows three pin bayonet coupling type. Double stub type available. Both types completely interchangeable with other miniature connectors.

BANTAM

ENVIRONMENTALLY-SEALED ELECTRICAL CONNECTORS

Electrically, mechanically, BANTAM connectors are designed for dependable performance despite environmental extremes. Copper alloy closed entry contacts, heavily gold-plated... moisture-proof resilient inserts...cadmium-plated shells of high-tensile strength aluminum... heavy spring tension for perfect interface sealing. Also available are potting boot and cable clamp types.

H. H. BUGGIE
DIVISION

BURNDY CANADA LTD.

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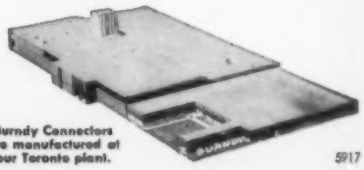
Offices in Montreal, Winnipeg, Calgary, Vancouver.



Burndy Connectors are manufactured at our Toronto plant.

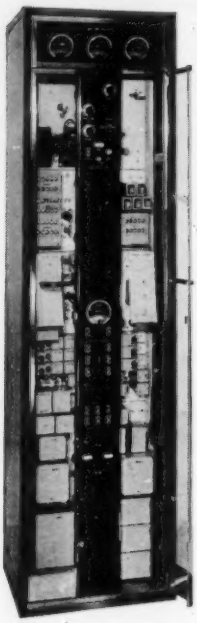
5917

For further information mark No. 21 on our Readers' Service Card

Westrex Corporation
A DIVISION OF LITTON INDUSTRIES

ANNOUNCES THE APPOINTMENT OF TELE-RADIO SYSTEMS LTD.

. . . as exclusive Canadian representative



Westrex Plexitel SSB H.F. Transmitting Terminal. Up to 4 voice or 64 teleprinter circuits simultaneously. 500 watts P.E.P.

With this appointment, the complete line of Westrex communications equipment becomes available to Canadian users. Westrex equipment is noted for its outstanding performance and unmatched reliability . . . proven by installations all over the world.

See the following Westrex equipment at the I.R.E. Canadian Convention:

- Plexitel (Type 8A4) Single Sideband Transmitter (illustrated) and type 52A4 Receiver
- Minitel transistorized LF/HF Radio Teleprinter Receiver
- Type 51FS Exciter (frequency shift)
- Type 6B1 Monatel radioteleprinter terminal
- Types 58A and 59 Privacy (speech inverter)
- Type 10 Receiver with Times facsimile printer
- Times Facsimile Discriminator and Westrex 49 Receiver
- Type 9A Single Sideband Transceiver

VISIT US AT BOOTHS 155-157 I.R.E. CANADIAN CONVENTION

TELE-RADIO — A complete communications supply house

Telephone carrier — Negative impedance repeaters — Voice frequency repeaters — Wire and cable — Program equalizers — Hybrid test sets.

VHF & UHF FM Mobile radio — portable transceivers — multi-channel UHF radio links — radio teleprinter receiving terminals — facsimile — single sideband — studio-transmitter links (sound or video) — voice and telegraph multiplex systems — marine and land HF radio.

Transistorized high-speed control and alarm systems — Selective calling and signalling systems.

Carrier Voltmeters — Milliwattmeters — Densiometers — Radar directional couplers and attenuators.

We are at the I.R.E. Canadian Convention to show you a number of new products. As specialists in communications, we look forward to discussing systems and equipment problems with old friends and new. We are particularly proud of our new association with Westrex. Come and visit!

TELE-RADIO SYSTEMS LTD.

3534 Dundas St. West, Toronto 9, Ont.

For further information mark No. 81 on our Readers' Service Card

Exciting

new developments
new products

see them at
The Northern Electric Booth E-14
I.R.E. CONVENTION
October 7th, 8th, 9th, 1959

Northern Electric
Company Limited
SERVES YOU BEST

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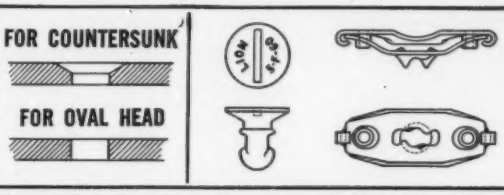
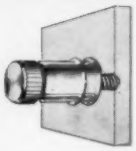
Captive Quick-Opening Fasteners:

Southco standards provide many benefits at low cost for access through doors, covers, panels and into drawers

LION ¼ TURN FASTENERS

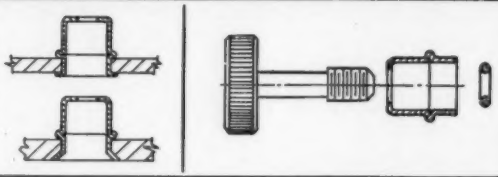
Quick, positive locking, by fractional turn. Tight seal formed by compression of leaf spring. Alignment and stack height not critical. Approved for aircraft use. Rugged. Extra strength provided by swaged nose. Vibration resistant.

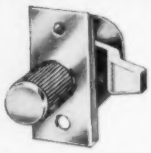




RETRACTABLE SCREW FASTENERS

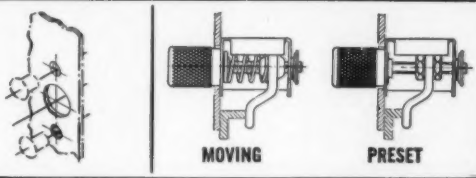
Stand-off thumb screws from stock to eliminate costly, special fasteners. Installed quickly without special tools. Accommodate misalignment. Complete range of standard sizes.





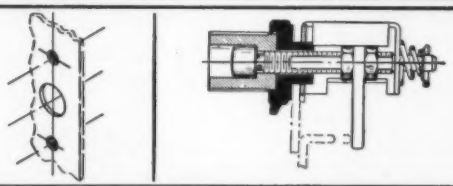
ADJUSTABLE PAWL FASTENERS

Pre-assembled, quickly installed. Accommodate variations in frame thickness up to ½ inch. One-quarter turn closes, additional turns increase grip pressure. Attractive appearance, long life. Moving or pre-set pawl. Miniature, intermediate and large sizes.



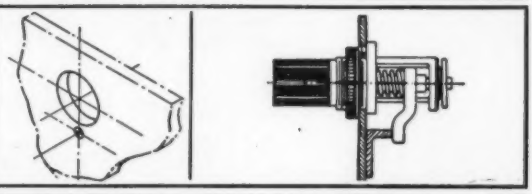
ADJUSTABLE PAWL FASTENER

Has twin-knob control. One knob controls pawl, pointer shows pawl position. Other knob controls amount of pressure to seal closure with uniform pre-set compression. Easily installed.



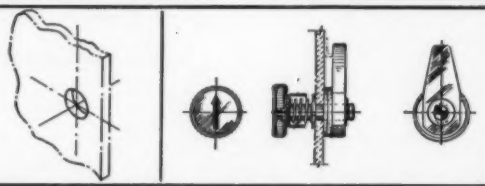
ADJUSTABLE PAWL FASTENER

Compact and rugged. Eliminates rivets or bolts to save installation time. Three types cover grip range up to ¾". Supplied either with integral metal and plastic knob, plastic knob or for your knob.



ARROWHEAD DOOR LATCH

Requires only one hole to install. Operates on quarter turn. Holds under spring tension. Arrow shows pawl position; no pawl stops required. Uses minimum inside space.



Free Fastener Handbook

Send to your nearest representative for your complete Southco Handbook, just printed.

SOUTHCO® FASTENERS

LION

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60 Lakeshore Dr., Valois
Montreal 33, Quebec

BLACK BROTHERS, LTD.
1200 Hornby Street
Vancouver, B.C.

WESTAIRE SALES CO.
380 Donald Street
Winnipeg 1, Manitoba

For further information mark No. 75 on our Readers' Service Card

the most powerful data processing system in its field

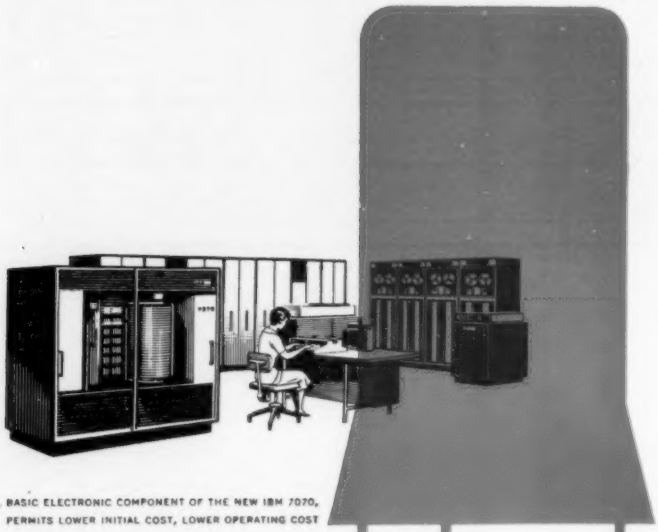
First fully transistorized IBM computer, the new IBM Seven-O-Seventy provides remarkable operating features for both business and science. Capable of handling complex calculations and everyday accounting problems, the IBM 7070 saves time, work and money.

Transistor design reduces space requirements, lowers initial costs and keeps your operating costs low. Also, it can give you information on your business previously impractical to obtain because of the cost. This helps you make decisions faster and helps you plan the growth of your business on a sounder, more factual basis.

And unexcelled IBM services—ranging from program planning to personnel education—work for you, helping to speed profitable operation and bring a maximum return on your data processing investment. For more complete information on the new IBM 7070 call an IBM representative today.

IBM

INTERNATIONAL BUSINESS MACHINES COMPANY LIMITED
Don Mills Road, Toronto 6, Ontario
BRANCH OFFICES IN PRINCIPAL CITIES ACROSS CANADA



THE TRANSISTOR, BASIC ELECTRONIC COMPONENT OF THE NEW IBM 7070, PERMITS LOWER INITIAL COST, LOWER OPERATING COST

NEW IBM 7070

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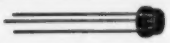
Transitron offers...

INDUSTRY'S MOST COMPLETE LINE

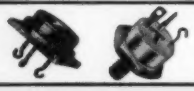
SILICON TRANSISTORS

JAN TRANSISTOR		Minimum Current Gain (B)	Maximum Collector Voltage (Volts)	Typical Cut-off Frequency (MC)	Maximum I_{co} @ 25°C and V_c Max. (μa)	FEATURES
	JAN-2N118	10	30	10	1	• Only Jan Silicon Transistor

SMALL SIGNAL		Minimum Current Gain (B)	Maximum Collector Voltage (Volts)	Typical Cut-off Frequency (MC)	Maximum I_{co} @ 25°C and V_c Max. (μa)	FEATURES
	2N333	18	45	7	50	• Low I_{co} • Operation to 175°C • 200 mw Power Dissipation
	2N335	37	45	10	50	
	2N480	40	45	11	.5	
	2N543	80	45	15	.5	
	ST905	36	30	10	10	

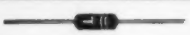
HIGH SPEED SWITCHING		Typical Cut-off Freq. (MC)	Maximum Collector Voltage (Volts)	Maximum Collection Saturation Resistance (ohms)	Max. Power Dissipation @ 100°C ambient (MW)	FEATURES
	2N1139	150	15	60	500	• High Frequency Operation • Low Saturation Resistance • Low I_{co}
	2N337	20	45	150	50	
	2N338	30	45	150	50	

MEDIUM POWER		Max. Power Dissipation @ 25°C Case (Watts)	Maximum Collector Voltage (Volts)	Minimum DC Current Gain (B)	Typical Rise Time (μsec)	Typical Fall Time (μsec)	FEATURES
	2N545	5	60	15	.3	.5	• Fast Switching • High V_c • Rugged Construction
	2N547	5	60	20			
	2N498	4	100	12			
	2N551	5	60	20			
	2N1140	3	40	20	.2	.1	

HIGH POWER		Maximum Power Dissipation .. 25°C Case (Watts)	Minimum DC Current Gain (B)	Typical Collector Saturation Resistance (Ohms)	Maximum Collector Voltage (Volts)	FEATURES
	ST400	85	15 @ 2 Amps	1.5	60	• High Current Handling Ability • Low Saturation Resistance • Rugged Construction
	2N389	85	12 @ 1 Amp	3.5	60	
	2N424	85	12 @ 1 Amp	6.0	80	

Write for Bulletins: TE-1353 and TE-1355

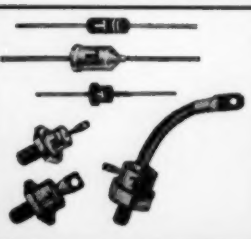
SILICON DIODES



FEATURES	Fast Switching and High Frequency Types Ratings @ 25°C				Military and High Conductance Types Ratings @ 150°C			
		Max. Inverse Voltage (Volts)	Max. Average Fwd. Current, (ma)	Inverse Recovery Time (μsec)		Max. Inverse Voltage (Volts)	Max. Average Fwd. Current (ma)	Max. Inverse Current (μa) @ V
• Recovery Times Under 15 μsec • High Conductance Combined With Fast Switching • Subminiature Size • High Inverse Resistance	1N808	100	100	.3	JAN 1N457	60	25	5 @ 60
	1N809	200	100	.3	JAN 1N458	125	25	5 @ 125
	1N658	120	200	.3	JAN 1N459	175	25	5 @ 175
	1N659	55	100	.3	1N485B	180	50	5 @ 175
	1N643	110	100	.3	1N488A	380	50	25 @ 380
	JAN 1N251	30	75	.15	1N464	175	40	30 @ 125

Write for Bulletin TE-1350

SILICON RECTIFIERS



Ratings @ 150°C Case Temperature		Peak Recurrent Inverse Voltage (Volts)	Maximum Average Forward Current (ma)	Maximum Inverse Current (ma)	FEATURES
Subminiature Glass	1N689 1N649	600 600	150 150	0.2 0.2 (@ 25°C)	• Reliability at High Temperatures • High Efficiency • Rugged Construction • Hermetic Sealing • Low Thermal Resistance
Miniature	TJ60A TJ30A	600 300	200 200	0.5 0.5	
Axial Leads	SL715 1N547	1500 600	100 250	0.2 0.3	
Military	JAN 1N256	570	200	0.25 (@ 135°C)	
Stud Mounted	TM155 TM67	1500 600	400 3000	0.5 0.5	
Medium Power	TR402 TR601	400 600	Amps 20 10	5 5	
High Power	TH402B	400	50	15	

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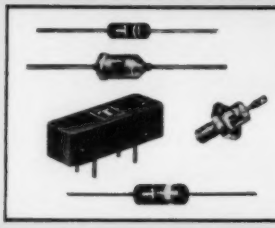
SILICON REGULATORS AND REFERENCES



	Voltage Range (Volts)	Maximum Dynamic Resistance (ohms)	Maximum Current @ 25°C (ma)	Maximum Current @ 125°C (ma)	FEATURES
Subminiature — SV-5	4.3-5.4	55	50	10	• Long-term stability • Operation up to 150°C • Small size, easy mounting • Hermetically sealed
Miniature — SV-815	13.5-18	120	40	8	
Power — SV-924	20-27	8	55°C (amps)* .4	(ma)* 100	
Stabistor — SG-22	.64	40	150	25	
Reference — SV-3176	8-8.8	15	Temp. Coefficient ≐.001%/°C		
Ref-Amp — 3N44	8.3-9.8		≐.002%/°C		

*Case temperature ratings

Write for Bulletin TE-1352

SILICON CAPACITORS

	Ultra High Frequency Types — Ratings @ 25°C						FEATURES
	Cut-off Freq. (mc)	Capacity (μμf) @ V Max.	@ −0.1V	Q @ −4V @ 50Mc	@ 100Mc	Maximum Working Voltage	
SCH-51	5000	.35	2	100	50	10	• Subminiature Size • High Q • High Temperature Operation
SCH-52	5000	.8	4	100	50	7	

	High Frequency Types					
				Q @ −4V At 5mc	At 50mc	
SC-1		4.4	24	350	35	22
SC-5		25	120	350	35	11
SC-15		120	360	350	35	6

Write for Bulletin PB-45

GERMANIUM DIODES

FEATURES

- Milli Microsecond Switching
- Superior Forward Conductance
- High Inverse Resistance
- Uniformity and Stability
- Gold Bonded Construction

Specifications and Ratings at 25°C	Forward Current @ +1V (ma)	Inverse Current at Specified Voltage (μa @ V)	Max. Oper. Voltage (volts)	Description
JAN-1N270	200	100 @ −50	80	JAN TYPES
JAN-1N277	100	250 @ −50 @ 75°C 75 @ −10	100	
JAN-1N281	40	500 @ −50 30 @ −50	60	
JAN-1N126	5	500 @ −50 30 @ −10	60	
JAN-1N198	5	250 @ −50 @ 75°C 75 @ −10	50	
1N283	200	20 @ −10	20	COMPUTER TYPES
T16G	40	100 @ −50	60	
1N278	20	125 @ −50 @ 75°C	50	HI-TEMPERATURE TYPES
T22G	40	20 @ −10 @ 75°C	15	
T9G	100	20 @ −50 2 @ −10	60	HI-RESISTANCE TYPES
1N67A	5	50 @ −50 5 @ −5	80	
T8G	100	20 @ −100 5 @ −10	100	
S570G	10	30 @ 6	Recovery Time .002 (μsec)	MILLI-MICROSECOND SWITCHING

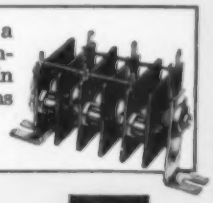
Write for Bulletin TE-1300 & TE-1319

GERMANIUM COMPUTER TRANSISTORS

	Minimum Current Gain (B)	Maximum Collector Voltage (volts)	Typical Cutoff Freq. (MC)	FEATURES
2N427	40	15	8	• High FrequencySwitching • Low Saturation Resistance • Uniform Input Characteristics
2N428	60	12	13	

Your local authorized TRANSITRON DISTRIBUTOR now carries in-stock inventories for immediate delivery.

Transitron's TD series of rectifier stacks offer a wide range of ratings in seven standard circuit configurations. High voltage cartridges, quads, plug-in assemblies, and many other special encapsulations are also available. Your inquiries are invited.
Write for Bulletin TE-1342.



Transitron

electronic corporation • wakefield, massachusetts

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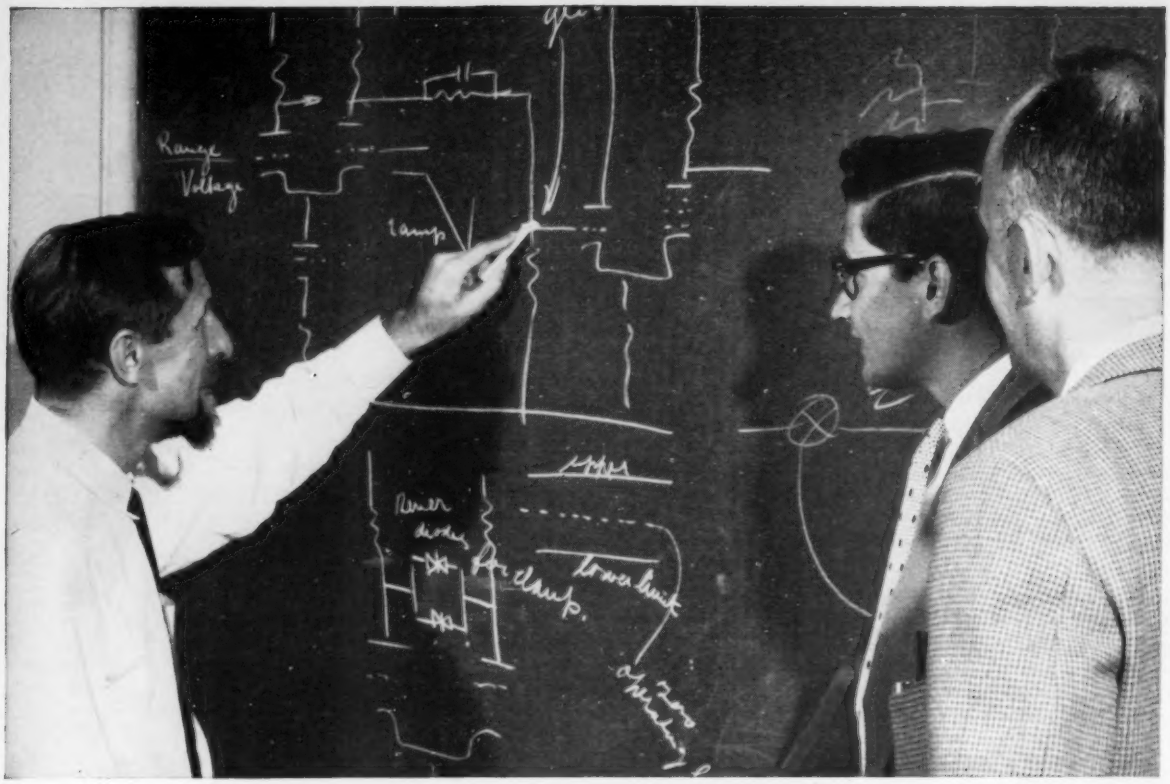

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Airborne Interceptor Simulator	—CF100
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The engineering offices of CAE are located in the head office, a modern, air-conditioned building on the outskirts of Montreal, close to suburban living and the Thruway route to the Laurentian playground.

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CANADIAN AVIATION ELECTRONICS LTD.
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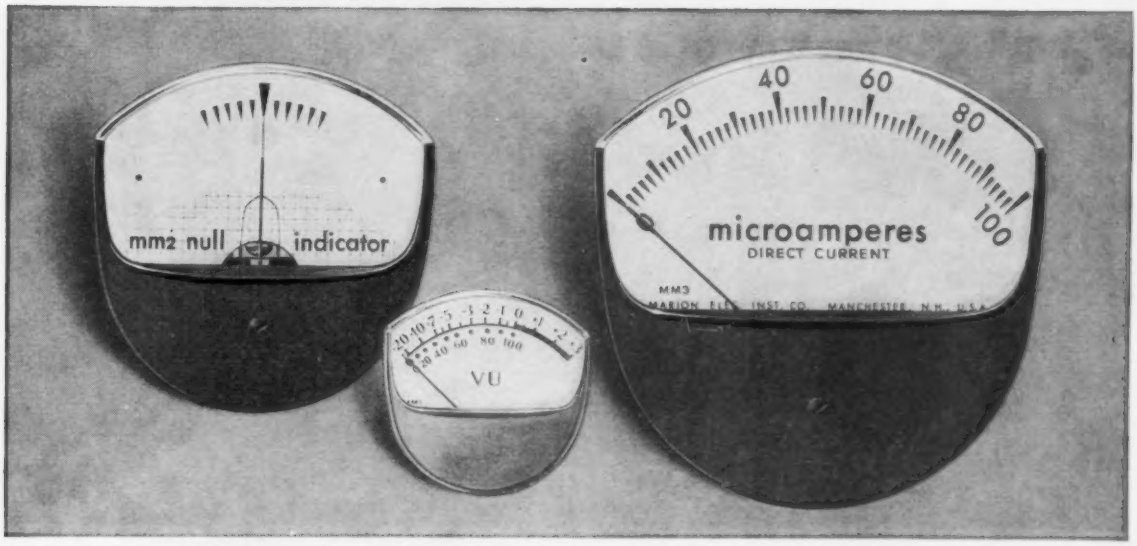
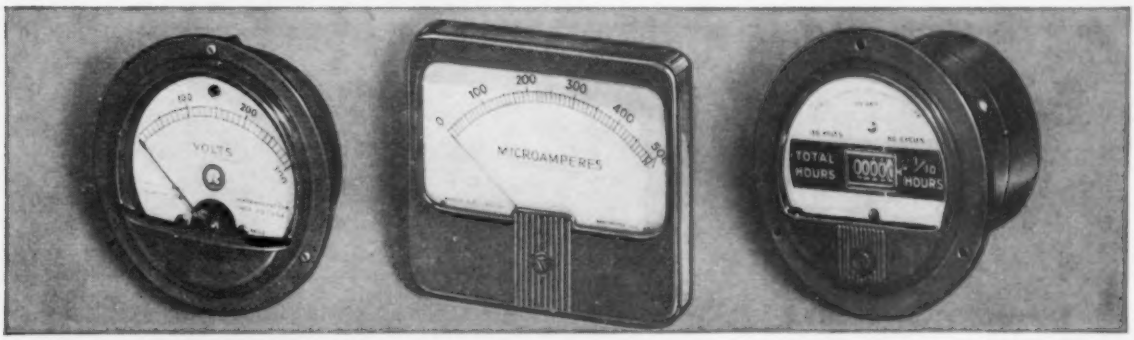
NOW AVAILABLE THROUGH HONEYWELL

marion electrical indicating instruments



MARION MEDALIST* METERS—ammeters, voltmeters, VU meters and null indicators—are panel instruments of advanced design, providing greater readability and modern styling in minimum space. Available in 16 standard case colors, or custom colors to match your equipment.



MARION RUGGEDIZED PANEL INSTRUMENTS are specially designed to withstand the most severe requirements of shock, vibration, stress and strain. They are hermetically sealed and immune to hazardous climatic and atmospheric conditions.

MARION STANDARD PANEL INSTRUMENTS for commercial applications provide improved performance at moderate cost.

MARION ELAPSED TIME INDICATORS, in hermetically-sealed or bakelite cases, record running times in maintenance programming, productivity and utilization studies.

Marion Electrical Indicating Instruments are the latest additions to the growing line of indicating, recording and controlling instruments available from Honeywell. Marion offers eight basic groups of electrical indicating instruments and related products, incorporating the most advanced design concepts and production techniques. For further information, write Honeywell Controls Limited, *Precision Components Division,* Toronto 17, Ontario.

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H marion meters

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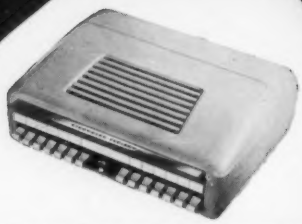
THE MOST COMPLETE RANGE OF COMMUNICATION SYSTEMS

Hackbusch Electronics Limited offer you a complete range of high quality Stromberg-Carlson communication and intercommunication systems. Each system represents the most outstanding development within its field—Pagemaster, Key-Municator, Dial-X and conventional sound systems. Complete equipment, replacement and parts facilities are maintained to provide the ultimate in coast to coast service.

PAGEMASTER provides direct, instantaneous, personal paging for key personnel within plants, hospitals, large offices, hotels and many others. Receivers have D.O.T. approval P1.



KEY-MUNICATOR a new concept in intercommunication—compact, has audio and visual signaling, can be expanded in multiples of 14 stations.

CONVENTIONAL SOUND amplifiers, speakers, microphones and record playing equipment. Also completely engineered systems for public address, paging, music distribution systems in schools, hospitals and music therapy systems.

DIAL-X solves communication problems by giving two systems, two phones —one for 100% service and one for 100% outside service. Dial-X reduces telephone costs.

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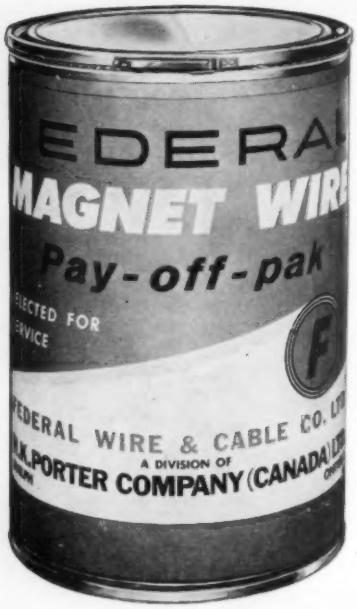
FEDERAL "Pay-Off-Paks"
pay off in *speed* and *profits*

This cost-reducing method of magnet wire packaging and handling, pioneered by Federal Wire in 1956, has been paying off in speed and extra profits on every installation. Simply open the container and thread. The wire pays off like a fisherman's line from a spinning reel. There are no backlash, overrun or inertia problems and most important—no stopping to solder during winding.



- One "Pay-Off-Pak" holds approximately 500 lbs. of size 12-23 magnet wire—replaces 10 reels—reduces soldering and downtime.
- "Pay-Off-Paks" eliminate need for a wide range of reel sizes.
- Reduced investment in returnable reels.
- Set-up time on the winding machines is cut to a minimum.
- Interlocking tops and bottoms allow storage in a minimum amount of space.
- Made of tough, reinforced fibre—standard-size container weighs only 22 lbs.
- Also sizes 24-29 available in 100 lb. "Pay-Off-Pak" and sizes 12-23 AWG in 250 lb. "Pay-Off-Pak."

Speed up production with a Federal "Pay-Off-Pak". You can depend on the quality of Federal Magnet Wire.

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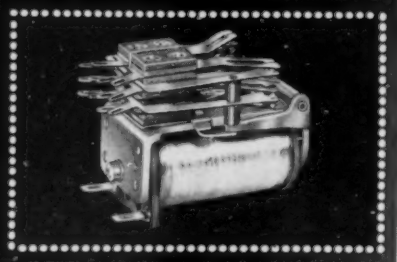
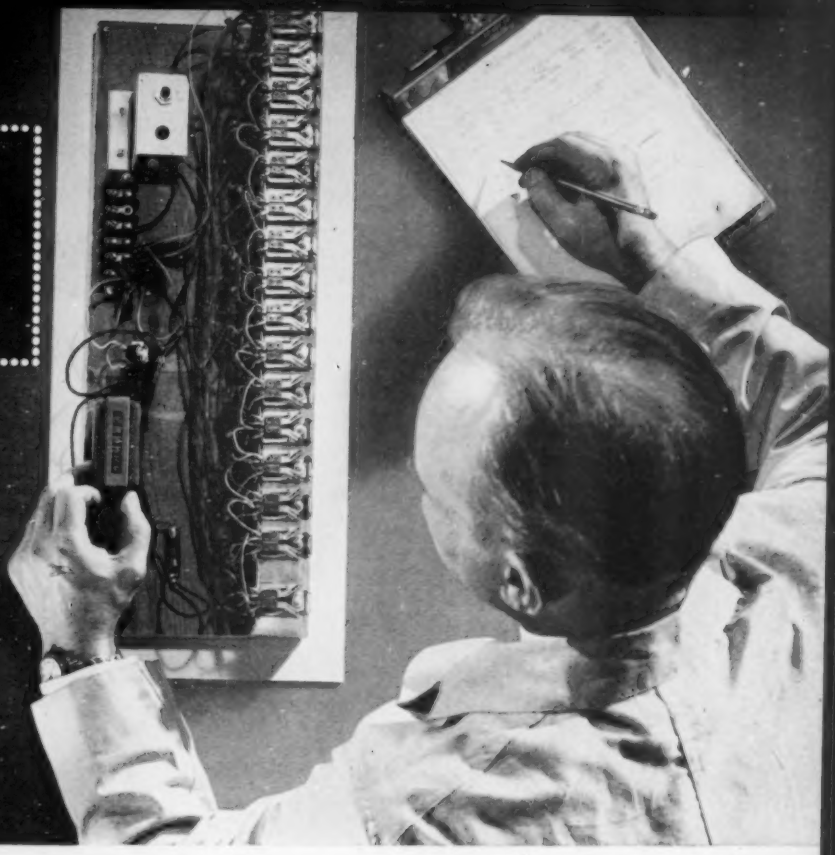




213,149,873 cycles

Test proves reliability of P&B's LS telephone type relay

These 16 LS relays, wired into a self-cycling chain, each operated 213,149,873 times before the test was discontinued. This test was made for a nationally prominent manufacturer and the certified results are available upon request.

Here is proof of the inherent reliability of P&B telephone type relays . . . and of the kind of performance you can expect when you specify them. LS relays are available with up to 20 springs (10 per stack) and are adaptable for printed circuit mounting.

Whenever multiple switching of loads up to 4 amperes is required, the LS can usually meet space, weight and—importantly—price considerations. Get full information today by calling or writing Zeke R. Smith, vice president, Engineering, or contact your nearest P&B representative.

LS ENGINEERING DATA

GENERAL:

Breakdown Voltage: 1,000 volts rms 60 cy. min. between all elements.
Ambient Temperature: —55° to +85° C.
Weight: 3 to 4 oz.
Dimensions: 1½" W. x 2⅜" L. x 1½" H. (4 Form C)
Enclosures: Sealed or dust cover (W can) Sealed or dust cover, up to 6 Form C, single contacts (D can)
Mountings: Four #6-32 tapped holes ¾" x ⅝" o.c. Other mountings available.

CONTACTS:

Arrangements: 20 springs (10 per stack) max.
Material: ⅛" dia. twin palladium. Other materials available for specific applications.
Load: 4 amps @ 115 volts 60 cy. resistive.

COIL:

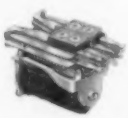
Resistance: 55,000 ohms max.
Power: 65 mw DC per movable standard (50 mw possible); 3.5 watts max. at 25° C.
Voltage: Up to 200 volts DC.

TERMINALS:

Contacts: Three #18 AWG wires.
Coil: Three #20 AWG wires.
Available with octal plug, taper tabs or printed circuit pins.

P&B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

TS RELAY
Short coil relay is available in AC and DC versions. Long life construction. Can be supplied (DC) with up to 20 springs (10 per stack).



GS RELAY
Excellent sensitivity: 50 mw per movable arm minimum (DC). For applications requiring many switching elements in small space.

BS RELAY
Long coil provides high sensitivity (25 mw per movable arm) and room for slugs for pull-in delays (150 milliseconds max.) or drop-out delays (600 milliseconds max.).

FREE
LS DETERMINATION DATA
Send today for booklet containing certified results of recent test described above. Data includes test circuit, interim and final measurements.

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COMPLETE COMMUNICATIONS SYSTEMS
FROM 5 WATTS TO 50 Kilowatts
Designed and Manufactured by TMC for
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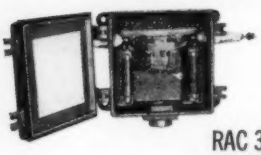
Another Typical TMC Installation

PLUS THE "HARD-TO-GET" INSTALLATION ACCESSORIES DIRECT FROM STOCK



RAC 30 BULLETIN 112B

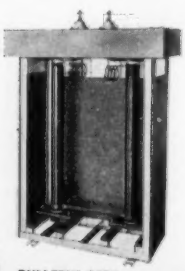
QDL BULLETIN 191

QDS BULLETIN 199

- TRANSMITTING and RECEIVING ANTENNA COUPLERS — REQUEST BULLETINS 218-112
- TRANSMITTING and RECEIVING TERMINATIONS — REQUEST BULLETINS 162-164
- NON-REACTIVE DUMMY LOADS — REQUEST BULLETIN 188
- TRANSMITTING and RECEIVING COAXIAL PATCH PANELS — REQUEST BULLETINS 197-210
- ANTENNA MULTICOUPLERS — REQUEST BULLETIN 203
- STANDING WAVE RATIO ANALIZER — REQUEST BULLETIN 198
- WIDE RANGE ANTENNA TUNERS — REQUEST BULLETINS 163-209
- VOICE FREQUENCY TELEGRAPH SYSTEMS — REQUEST BULLETIN 167
- RG/17, 18, 35, 85, 164U COAXIAL CONNECTORS — REQUEST BULLETINS 162, 164, 191, 197, 199
- QDL-QDS COAXIAL CONNECTORS — REQUEST BULLETINS 162, 164, 191, 197, 199
- TRANSIT CASES • HYBRIDS and LIMITERS
- COMPLETE RADIO TELETYPE SYSTEMS

ATS BULLETIN 209

QDP BULLETIN 197



TER 5000 BULLETIN 188A

SSP-3 BULLETIN 210

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NOW YOU CAN CALIBRATE YOUR OWN PORTABLE PRECISION INSTRUMENTS

WESTON'S MODEL 60 SERIES CALIBRATORS

● MORE ACCURATE than the conventional laboratory standard instrument—Weston's new Instrument Calibrators provide accuracy of 0.05% of indicated value!

● AUTOMATIC OPERATION, controlled by a single technician—on a job that previously took two highly trained specialists!

● A COMPLETE STANDARDIZATION LABORATORY for portable precision measuring instruments—the answer to costly delays awaiting calibration by independent or government laboratories!

Using an AC instrument calibrator—one of four new calibration consoles now available from Daystrom's Weston Instruments Division—a laboratory technician sets up the simplified switching circuit to check a 10-ampere meter with 10 cardinal points. The operator, now starting his check on the tenth point, completes the check of the instrument without need of another operator to check the monitor.

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Booth 142 Date October 7-8-9

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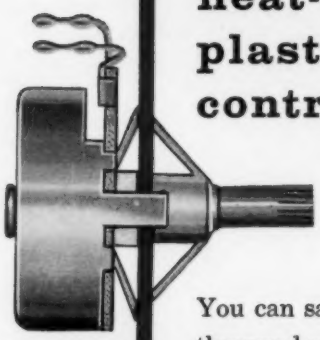
Save on labor costs

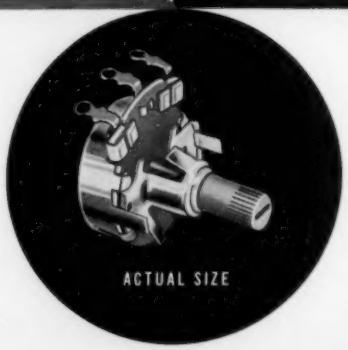
Centralab's heat-stable plastic shaft controls



SNAP into place

You can save on installation costs—up to $10.00 per thousand units—because CENTRALAB Model 2 variable resistors SNAP into position.*

This exclusive "Snap-Tite" design is but one of the many features that make the Model 2 so practical. The thermo-setting plastic shaft is UL approved. You have a choice of six shaft lengths—and the shafts have service adjust screwdriver slots front and rear. The shaft and contact rotor are molded in one piece for rigid, vibration resistant construction.



SPECIFICATIONS

Resistance element: Composition
Resistance range: 250 ohms to 10 megohms
Taper: Available in seven standard tapers
Effective Rotation: 300°
Shaft Lengths: ⅜", ½", ⅝", ¾", ⅞", 1"
Terminals: Standard, plug-in or wire-wrap
***Mounting:** Interchangeable with panel piercing for bushing and twist tab mount

Further information and detailed engineering data available in CENTRALAB Engineering Bulletin EP-815. Write for your free copy.

Centralab
B5971

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VARIABLE RESISTORS • ELECTRONIC SWITCHES • PACKAGED ELECTRONIC CIRCUITS • CERAMIC CAPACITORS • ENGINEERED CERAMICS

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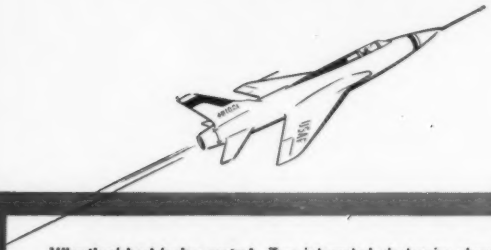
vital electronic equipment is *"soft mounted"* on F-105

Critical electronic units on the Air Force's Mach 2 F-105 Thunderchief fighter-bomber are "soft mounted" on LORD vibration control systems. Operational reliability is thus assured for a toss bomb computer, sight amplifier and two integrated electronics chassis.

Use of resilient suspension systems—custom designed—provides positive protection against the extreme disturbances of the advanced jet environment. By working with LORD, F-105 contractors obtained the lightest, most economical suspensions in the shortest time.

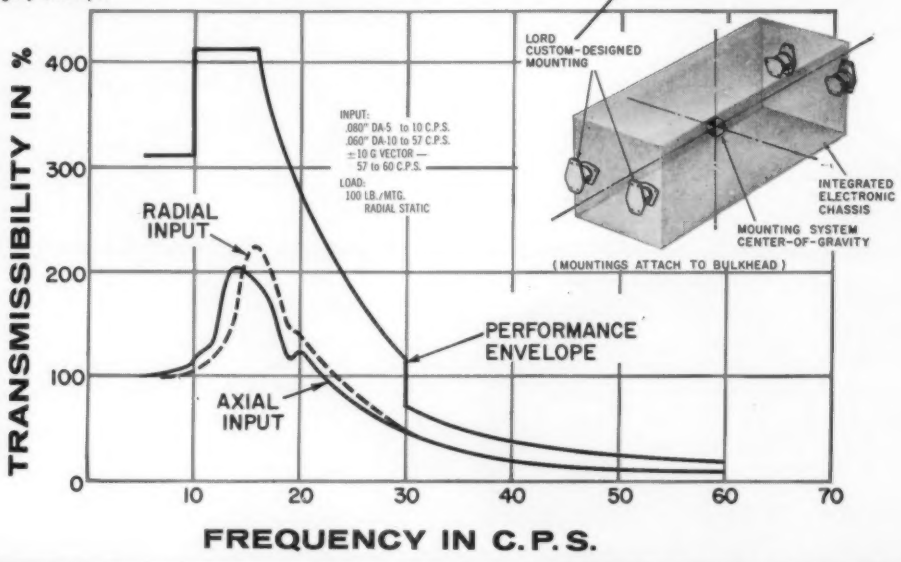
If you have a problem in the protection of sensitive equipment, LORD offers you a broad background of vibration/shock/noise control experience in air, space, marine and ground environments. Your inquiry will be welcomed.



Vibration/shock/noise control—Two integrated electronics chassis on Republic F-105 jet fighter are mounted on special Lord high-performance isolators. Severe environment includes vibration, superimposed sustained accelerations to 9 G and 30 G shock loads throughout temperature range from — 65° to + 200° F.

In final design shown, four isolators weighing less than 1.5 pounds each support chassis weighing between 266 and 400 pounds. Use of Lord BTR (Broad Temperature Range) elastomer assures excellent damping plus constant performance over wide temperature range.

Transmissibility curve shows how efficient vibration isolation keeps equipment well inside fragility envelope.



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The Minirack M977 double-beam oscilloscope

CATHODE-RAY TUBE. '20th Century' D6B, 6-inch diameter, flat-faced and having two separate guns with independent controls. Sensitivity at 2Kv. E.H.T supply: Y=24 volts/cm. (61 volts/inch). X=25 volts/cm. (63 volts/inch). Sensitivity with amplifiers at maximum gain: Y=30 millivolts/cm. X=120 millivolts/cm. Graticule: Illuminated anti-parallax graticule showing two X and one Y axis.

Y AMPLIFIERS. Input Impedance: 2·2 megohms shunted by 15 pF approx. Input R.C. coupling time constant: 0·22 seconds. Input Attenuator: 10:1 frequency compensated. Amplification: 26 to 800 continuously variable. Signal Calibration: ±2 volts in 0·1 volt divisions. Calibration Accuracy: ±5%. Frequency Response: D.C. to 100 Kcps 10% down. D.C. to 150 Kcps 30% down. Output Swing: 400 volts at a mean level of 150 volts above earth. Linearity of output: ±2%.

X AMPLIFIERS. Input Impedance: 1 megohm shunted by 50 pF approx. Amplification: 11 to 210 continuously variable. Frequency Response: D.C. to 150 Kcps 10% down. D.C. to 300 Kcps 30% down. Output Swing: 440 volts at a mean level of 150 volts above earth. Linearity of output: ±2%.

TIME-BASE. Calibration Accuracy: ±25% on range 100 millisec—10 seconds. ±10% on range 0·3-30 millisec. Output: Positive going sweep ±10 volts about earth. Minimum internal sync. amplitude; 1 cm. Minimum external sync. amplitude; 1 volt peak-to-peak. The sync. amplifier is self-limiting.

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OVERALL DIMENSIONS. Height: 19 inches (48 cm.). Width: 15 inches (38 cm.). Depth: 23 inches (58 cm.). Weight: 75 lbs. (36 Kg.).

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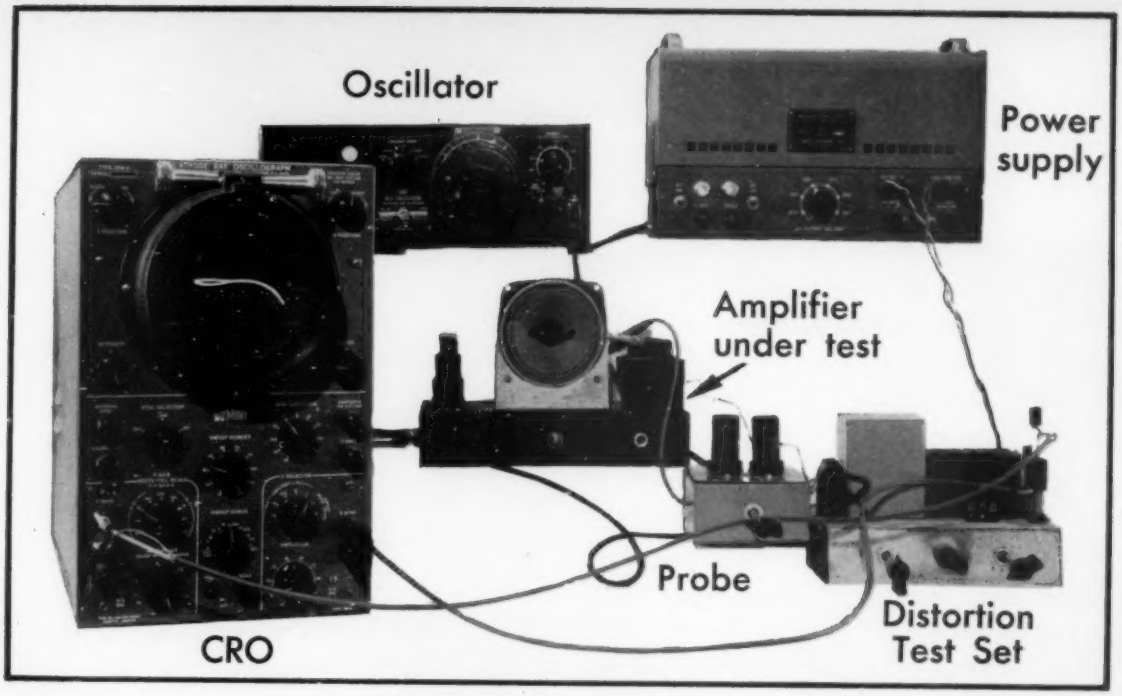

Continuous cro display simplifies amplifier distortion testing

A method of observing, directly, the non-linearity of an amplifier is of great value in design work. A cro display of properly phased input and output voltages is not sufficiently sensitive, but the deviation from linearity of the transfer characteristic will provide a sensitive display.

G. W. HOLBROOK P.ENG*

The non-linear distortion occurring in vacuum tube and transistor amplifiers is usually in terms of either:

a) The relative magnitudes of the fundamental frequency and its various harmonics appearing in the output when a pure sine wave is impressed on the input.

or

b) the relative values of the intermodulation products produced when two sine waves of equal amplitude and of different frequencies are applied to the input.

The former method of testing is usually the easier to apply and some indication of the type of non-linearity can be obtained by examining the relative magnitude of each harmonic. A symmetrical non-linearity, as found in push-pull output stages, generally gives rise to odd order harmonics—the third, fifth, seventh, etc. On the other hand, an asymmetrical non-linearity, exemplified by an approach to cut-off in a single-ended stage, will result in a preponderance of even order harmonics.

The measurement of intermodulation products will frequently give a better indication of higher order terms in the power series of the transfer characteristic than will a simple harmonic measurement. An analysis of the harmonics and intermodulation products produced by an amplifier whose transfer characteristic can be written as a power series has been made by Callendar and Griffiths.[1] This analysis includes a very useful set of tables of harmonics up to the sixth and intermodulation products of the same order.

If corrective measures are to be taken to improve the non-linear distortion of an amplifier either of the above methods becomes somewhat tedious in assessing the value of the correction. For each change made in the circuit a series of harmonic or intermodulation measurements must be made and these must be analyzed before the value of such a circuit change can be evaluated.

A method of observing, directly, the non-linearity of an amplifier is obviously of great value in such work. In general, a simultaneous cro display of properly phased input and output voltages will result, for most amplifiers, in a trace which is indistinguishable from a straight line. If, however, the deviation from linearity of the transfer characteristic can be displayed, a much more sensitive method of measurement is possible. The following paragraphs describe such a measurement involving a minimum of equipment. It is essentially a simplification of a method suggested by Wigan[2], and can be applied to single or multi-stage amplifiers employing either vacuum tubes or transistors. In addition to supplying a continuous indication of deviation from linearity, the same equipment can be used to measure, directly, the total percentage harmonic distortion.

Fig. 2 illustrates the transfer characteristics OPQ of a

*Royal Military College of Canada, Kingston, Ont.

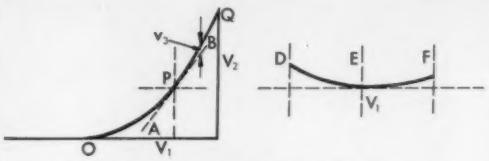

Fig. 2. Single ended amplifier characteristics

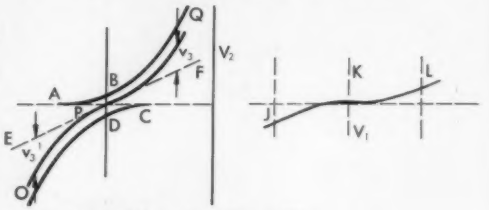

Fig. 3. Class AB push-pull amplifier

single ended triode amplifier in which the non-linearity has been somewhat exaggerated. The straight line AB represents an ideal linear characteristic tangential at the quiescent operating point P. For any particular value of instantaneous input voltage v_1, a corresponding output voltage v_2 is obtained. This, in the case shown, will be in excess of the ideal output by an amount v_3, the difference voltage. For negative grid swings the change in v_2 is less than the ideal and thus the difference voltage is still positive in sign.

If the equation of the line OPQ around the point P is expressed as

$$v_2 = f(v_1)$$

and the equation of the line AB is given as

$$v_2 = kv_1$$

then the difference voltage is expressed as

$$v_3 = (fv_1) - kv_1 \quad . \quad . \quad . \quad . \quad . \quad (1)$$

If v_2 is now attenuated by a factor k and the phase of v_1 reversed, the resultant voltages can be added algebraically to give a voltage proportional to this difference:

$$\frac{v_3}{k} = \frac{f(v_1)}{k} - v_1 \quad . \quad . \quad . \quad . \quad . \quad (2)$$

If this voltage difference is displayed on the Y axis of a cro and the X axis is swept simultaneously by V_1 then a trace as indicated is observed, providing that adequate adjustment of the phase of the horizontal sweep is made. The vertical displacement of the line DEF from the horizontal through E is proportional to v_3 for any instantaneous value of v_1.

Symmetrical non-linearity is exemplified in Fig. 3 which illustrates a class AB push-pull amplifier. Here the line OPQ represents the resultant transfer characteristic of the two tubes each represented by ABQ and CDO, respectively. The line EPF represents the ideal linear transfer characteristic and the difference voltages v_1 and v_3' are as indicated for positive and negative swings of input signal. The corresponding cro trace is shown at JKL and it will be noted that the sign of v_3 now changes with the sign of v_1.

If the function

$$v_2 = f(v_1) = f(v_m \sin \omega t)$$

can be expressed as a power series of Vm then it can be shown that the resultant in either of equations 1 and 2 will consist of the sum of various harmonics of the fundamental frequency. The effective value of these harmonics compared with the effective value of either V_2 or kV will give a measure of the relative harmonic content.

% harmonics with respect to total output = V_3/V_2 x 100.

% harmonics with respect to fundamental = V_3/kV_1 x 100.

A block diagram of the over-all test equipment required to achieve this result is shown in Fig. 4. It is shown also on page 41. The 1,000 cps oscillator must possess a good waveform and should, preferably, have a harmonic content of less than 0.1%, although higher values are tolerable if distortions of greater than 1% are to be measured.

The Distortion Measuring Set shown in Fig. 5, consists of the input transformer T1 which provides a one-to-one independance match between the oscillator and the variable attenuator A1 through one half of each of the primary and secondary windings. The phase shifting circuit C1, P1, is connected across the whole of the primary and provides a signal of constant amplitude and variable phase to drive the X plates of the cro. The phase shifting network, connected across the whole of the secondary provides a variable phase and constant amplitude voltage as a reference voltage to the grid of the cathode follower VT1.

The output transformer T2 provides either balanced or unbalanced output to the input of the amplifier under test. Impedance matching to the variable attenuator is achieved by R1. The turns ratio of the transformer and the ratio of the output taps depends largely on the signal level required to drive the amplifier under test. The output impedance of this transformer may be critical from the point of view of harmonic production within the amplifier. This is particularly noticeable in certain transistor amplifiers where the non-linear distortion is a function of the driving source impedance. In such cases a very low impedance output winding should be chosen and a suitable and known amount of series resistance included in the input circuit of the transistor amplifier to stimulate operating conditions.

The output signal from the amplifier under test is obtained by means of a short, low-capacitance probe which feeds the potentiometer P3 through the series capacitor C4. The output of the cathode follower VT2 is added to that of VT1, through the primary winding of T3. Decoupling of dc voltages is obtained by means of the capacitor C3 connected in the split of this winding. The resultant of this adding circuit is obtained in the secondary of T3 which is suitably loaded to match the output impedances of the cathode followers by means of R4.

Testing for distortion

The sequence of operations required to perform a distortion test is as follows:

a) The output of the oscillator is adjusted to give a reference voltage V_1 a value well within the linear range of VT1. This may be established by measuring the level at the point X by means of the vtvm and setting it at a convenient value of 1 volt rms.

b) The attenuator A1 is adjusted to give the desired output level from the amplifier under test.

c) P3 is then adjusted to give a level of approximately 1 volt at the point Y. This corresponds to V_2/k.

d) P2 and P3 are then successively adjusted to give a minimum reading at the point Z. This corresponds to V_3.

e) P1 can now be adjusted to give the desired trace on the cro.

f) The percentage harmonic can be obtained directly from the vtvm readings:

% harmonic
= 2 (Reading at Z x Turns Ratio T3) x 100 . . . (3)

The factor of 2 in the numerator of equation 3 is due to the division of the difference voltage equally over the internal impedance of the cathode followers and the primary impedance of T3.

Typical results

Figures 6a, 6b and 6c illustrate typical types of distortion encountered in a common-emitter transistor amplifier and in each case the horizontal displacement of the oscillogram represents an output voltage of 1 volt rms. Fig. 6a shows the type of distortion that occurs when insufficient bias is applied and is similar to the single ended condition described in Fig 2. Fig 6b shows the effect of excessive bias; the hook on the left of the trace indicates collector bottoming on negative peaks of input signal. Fig. 6c illustrates correct bias with a consequent decrease in percentage harmonics.

Figures 6d and 6e illustrate the type of oscillogram obtained with a single ended triode amplifier. Fig. 6d illustrates the effect of excessive bias and represents an output voltage of 15 volts rms. Fig. 6e shows the effect of extreme overdrive in a correctly biased amplifier. The loop in the right hand edge of the diagram represents the effect of grid current as the tube is driven into the positive grid voltage region.

Fig. 6f is a typical example of a push-pull vacuum tube amplifier with optimum bias. The blurred outline in this case is due to a slight amount of hum present in the output of the amplifier.

Conclusions

The main value of the method described in the preceding paragraphs lies in its ability to give a visual and continuous indication of the cause of non-linear distortion in a system. Such a method allows an immediate assessment of the improvement, or deterioration, in the harmonic content achieved by modifications to the operating conditions. In addition it allows for the simultaneous measurement of the total harmonic content of the system under test. A minor limitation exists in the fact that the phase shifting networks will not operate efficiently over a wide band of frequencies; this, however, can be eliminated by arranging band-switched capacitors in these networks. The main requirement is a comparatively highly sinusoidal source for driving the device, the remainder of the equipment being relatively inexpensive. END

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1. Relations between amplitudes of harmonics and intermodulation frequencies, by M. V. Callendar and S. Mathews. Electronic Engineering, Vol. 23, 1951, pp 230-232.

2. Diagnosis of distortion, by E. R. Wigan. Wireless World, Vol. 59, 1953, pp 261-266.

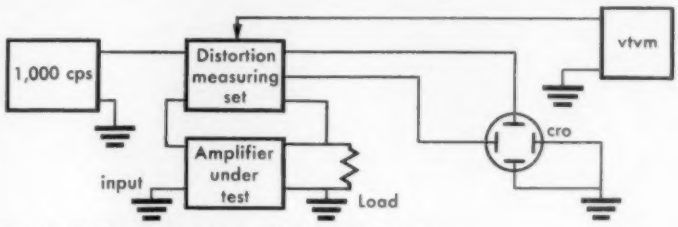


Fig. 4. Block diagram of overall test equipment

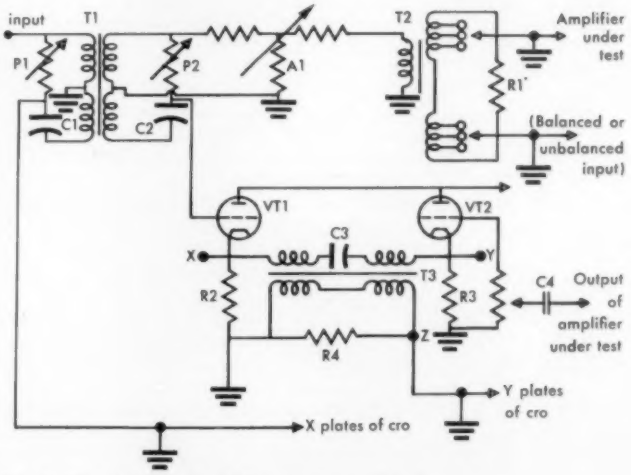


Fig. 5. Circuit diagram of distortion measuring set

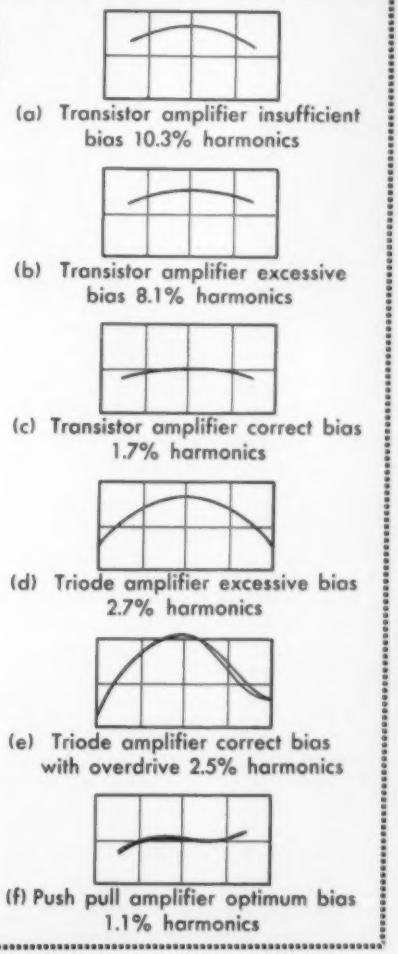

(a) Transistor amplifier insufficient bias 10.3% harmonics
(b) Transistor amplifier excessive bias 8.1% harmonics
(c) Transistor amplifier correct bias 1.7% harmonics
(d) Triode amplifier excessive bias 2.7% harmonics
(e) Triode amplifier correct bias with overdrive 2.5% harmonics
(f) Push pull amplifier optimum bias 1.1% harmonics

Fig. 6. Typical examples of distortion encountered

What's up there?

A summary of latest data on earth's environments up to 1000 kilometres

A. P. HARRIS, P.ENG. & E. W. PARROTT, P.ENG.*

In the atmosphere that surrounds the earth there are many environments visible and invisible, mild or destructive and of various degrees of importance to military designers.

There are conditions which the environmental test engineer is called upon to simulate in his laboratory—with only moderate success in many cases as the phenomena that nature produces casually can be achieved synthetically only by considerable effort and expense.

The natural condition is, however, the target and it is helpful to summarize and review these conditions particularly as new information is being added which may modify our old methods and add new objectives for simulation.

To review each natural environment in detail is a task beyond the intent of this paper. This is a synopsis of primary features for the guidance of the design and test engineer.

We hope to present a useful summary of the earth's environments and to mention their nature, their magnitude, their variation with altitude up to 1,000 Km (3,200,000 feet), and their inter-relation.

We are considering only the free natural environments and not those which are a function of the man-made vehicle. Mechanical shock, vibration, explosive conditions and such are excluded.

Further, we are not dealing with animal life or submarine conditions.

Our environments fall into three main categories, Atmospheric Solids, Atmospheric Gases and lastly the conditions involving Fields, Radiant Energy and Particles. As

*CAMESA, Department of National Defence, Ottawa.

electromagnetic phenomena are not usually listed as classes of environments, the test engineer may ask why they are included. The answers are that, firstly, the picture is not complete without them; secondly, it is impossible to consider some physical environments accurately in the absence of these conditions; and, thirdly, some field, radiant and particle conditions are just as annoying and just as difficult to design around as the more common environments.

ATMOSPHERIC SOLIDS

We shall consider the solids in the atmosphere under the headings Salt Spray, Fog and Clouds, Rain, Snow and Ice, Sand, Dust and Smoke, Fungi and Bacteria, and Meteors.

Salt spray

As a result of the action of breaking waves and high winds, fine particles of sea water are picked up from the sea and carried into the atmosphere as a mist or fog. Some of the water in these particles evaporates and leaves minute particles of the dissolved salts (Table 1) in a fine enough state of subdivision to be suspended in the air. These mists, or fogs, composed of both wet and dry particles, have been detected as far as 16 Km inland and up to altitudes of 20 Km.

The greatest concentrations are, however, within 300 meters of the shore and below 152 meters (500 ft.).

Particles of salt may even be borne up to heights of 82 Km to form condensation nuclei for clouds of ice crystals.

Fog and clouds

Fogs and mist occur when the temperature and dew point of air, having a high moisture content and a supply of hygroscopic nuclei, become identical. These conditions occur most frequently when cold air exists above warm, moist soil. The hot ground vapors are then condensed by the colder air after first saturating the colder air.

Mists can occur at greater altitudes and are then referred to as clouds. These are of three main classes.

1) Common clouds, comprising water droplets immersed in air, both being above freezing point.

2) Supercooled clouds, where the air is at, or below, freezing point.

3) Ice crystal clouds, comprising tiny ice crystals suspended in air, both crystals and air being below freezing point.

The mean water content of clouds is 0.3 to 1.0 grams per cubic metre although a maximum content of 5 grams is possible. The mean diameter of the droplets in clouds is 2 to 20 x 10^{-4} cm so that only one millionth of the volume of a cloud is water.

The source of water vapor for high humidities, mists and clouds is principally the sea surfaces from where it is swept upward by vertical winds.

In the category of clouds comes the phenomenon referred to as Noctilucent clouds. These clouds, visible at night with a luminosity of 0.4 candles per square centimeter, are at a constant height of 82 kilometres and cover vast areas of the order of tens of thousands of kilometres square. They are composed of tiny ice crystals and travel at speeds up to 200 metres per second and always greater than 15-20 metres per second. The most probable mode of formation of these clouds is by direct combination of hydrogen with dissociated oxygen molecules.

Clouds can only be formed when the atmospheric pressure exceeds the elasticity value for saturated water vapor. Due to the temperature and pressure variations in the atmosphere, the elasticity is the smaller only below an altitude of 33 kilometers and in the region of 79 to 84 kilometres. The physical explanation of this phenomenon is shown in Fig. 1. Thus only in these regions can clouds be formed and these correspond to the weather clouds and noctilucent clouds.

Cloud formations control local surface temperatures and precipitation and attenuate electromagnetic radiation.

Element	Parts per million
Chlorine	18980
Sodium	10561
Magnesium	1272
Sulfur	884
Calcium	400
Potassium	380
Bromine	65
Carbon	28
Strontium	13
Boron	4.6
Silicon	0.02-4.0
Fluorine	1.4
Nitrogen (in compound forms)	0.006-0.7
Aluminum	0.5
Rubidium	0.2
Lithium	0.1
Phosphorous	0.001-0.10
Barium	0.05
Iodine	0.05
Arsenic	0.002-0.02
Manganese	0.001-0.01
Copper	0.001-0.01
Zinc	0.005
Lead	0.004
Selenium	0.004
Cesium	0.002
Uranium	0.0015
Molybdenum	0.0005
Thorium	0.0005
Cerium	0.0004
Silver	0.0003
Vanadium	0.0003
Lanthanium	0.0003
Yttrium	0.0003
Nickel	0.0001
Scandium	0.00004
Mercury	0.00003
Gold	0.000006
Radium	0.2-3 X 10^{-10}
Cadmium	present
Cobalt	present
Tin	present

Table 1. Analysis of elements present in solution in sea water, exclusive of dissolved gases.

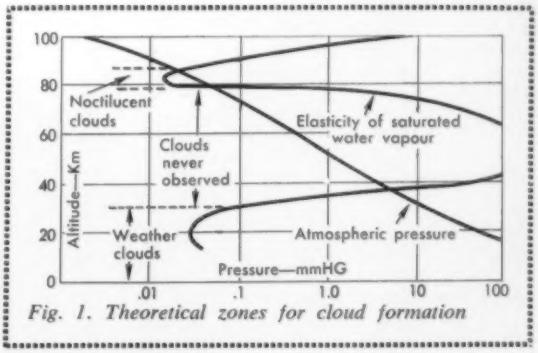


Fig. 1. Theoretical zones for cloud formation

Rain drop diameter (mm)	1	2	3	4	5	6
Terminal velocity (metres per second)	4.8	6.6	8.1	8.9	9.25	9.3
Free fall height for 95% of terminal velocity (metres)	2.2	5.0	7.2	7.8	7.6	7.2

Table 2. Size, terminal velocity and free fall height of rain drops.

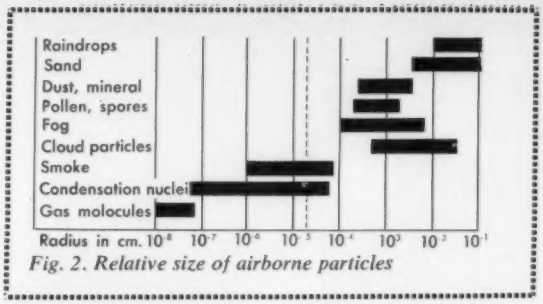


Fig. 2. Relative size of airborne particles

Rain, snow and ice

As the atmosphere is constantly taking up moisture, to maintain a dynamic equilibrium it must reject some of the moisture absorbed. This it does in the form of rain, snow and ice, a familiar phenomenon.

Some of the water is rejected in the form of rain drops of sizes up to 7 mm in diameter according to their history of formation and height of fall.

The terminal velocities of different size raindrops and the equivalent free fall heights are given in Table 2.

The free fall height is the height from which a raindrop achieves the same terminal velocity as if dropped from a cloud.

Impurities occur in rain in varying amounts up to 430 parts per million and consist mostly of dissolved and combined oxygen, nitrogen, and carbon dioxide. Nitrogen occurs as nitric acid, ammonia and nitrates, these being formed by lightning discharges. The maximum concentrations of impurities occur near the sea due to the effects of salt spray mentioned earlier. In towns rain may contain comparatively large concentrations of sulphuric and sulphurous acids.

Not all the moisture rejected by the atmosphere reaches the ground in liquid form. Much becomes frozen and appears as snow, ice, sleet, or hail.

The actual snow crystals vary from less than 1 mm to 1.5 mm, but snowflakes can be up to 45.8 cm (15 inches) by 20.2 cm (8 inches).

When the moisture of the atmosphere is precipitated as sleet, the usual grain size is up to .45 cm (0.16 inches) diameter and is formed by the freezing or rain drops. But hail, which is normally composed of balls or irregular lumps of ice between .2 cm (.08 inches) and .5 cm (0.2 inches) diameter, can be as large as 12.7 cm (5 inches) diameter and weigh .68 kgms (1½ lb). These large 12.7 cm diameter hailstones require the existence of upward currents of air of speeds around 320 Km/hour (200 mph) and a 7.5 cm (3-inch) diameter stone requires a 160-Km/hour (100 mph) current for its formation.

Obviously, to design against this last environment is wasteful and usually unnecessary.

	Most favorable	Destroyed
Moisture content of nutrient.		
Fungi	8% and up	
Bacteria	10 to 100%	
Moisture content of air. F and B	70 to 100% RH	
Temperature.		
F and B	10 to 38 deg C	90 C for 20 min.
Light. F and B	Not required	Strong ultraviolet
Oxygen.		
Fungi	Required	
Bacteria	Not required	
pH range		
Fungi	4 to 7	
Bacteria	7 to 8.5	
Nutrient element required for Fungi	C, H, N, S, K, Mg, P, trace elements.	

Table 3. Environment for fungi and bacteria.

Sand, dust and smoke

A great many varieties of solid particles exist in the atmosphere. These include wool, cotton, and other hair-like particles, plant pollen and spores, carbon, ash, minerals, salt, glass and a variety of cosmic particles. Their geographic distribution is obviously extremely variable and there is as well a daily and seasonal variation depending on the location.

By definition a sand particle is one greater than 4×10^{-3} cm in radius and dust particles are less than 4×10^{-3} cm radius.

The relative sizes of these and previously mentioned particles are shown in Fig. 2.

Mineral and inorganic dust particles are usually angular in form and abrasive. They may also be hygroscopic. Most airborne plant particles are hairlike while spores are usually spherical.

The dotted line in Fig. 2 shows the limit of optical visibility. Condensation nuclei are particles, in either liquid or solid form, upon which moisture condenses to form water droplets. Their sizes run from 7×10^{-5} cm radius and are shown in comparison with the size of gas molecules.

Their presence has a considerable bearing in fog, cloud and rain conditions. Without them there would be no rain.

Over the rural areas there are up to 300 solid particles per cubic cm, over small cities 3,000 and over major industrial areas 30,000 particles per cubic cm.

Their distribution with Altitude is as follows:

Sand—(as defined) about a meter

Dust and smoke—to 3 Km

Condensation nuclei—to 10 Km and possibly 82 Km.

Fungi and bacteria

While fungi and bacteria are normally a ground environment they do become airborne and for this reason have been included in the figure.

Fungi are thread-like in shape and reproduce by spores which compare with the seeds of ordinary plants. Small nonparasitic fungi are called molds.

Bacteria are simpler in structure, often single-celled. Most are able to carry on photosynthesis. They reproduce by division of their cells and in many cases produce a

hardy spore within the individual bacteria cell.

Mold, fungi and bacteria are more common and active in tropical and temperate areas than at the poles where conditions for growth are less favorable. They occur within the soil and spores and bacteria because of their size may be carried to several kilometers.

The most favorable environmental conditions for growth are shown in Table 3.

From these factors it is apparent that polar areas are most free from fungi and bacteria. It might also be deduced that the extremes of temperature and intense solar radiation at very high altitudes would destroy most fungi and bacteria although it has been stated that very hardy forms might exist even in outer space.

Meteors and meteorites

Meteoric particles originating in space strike the earth's atmosphere at relative speeds up to 70 Km per sec and the particles are heated to boiling point by air friction and completely evaporated within seconds giving off a bright light in the process and leaving trails of ionized particles.

Incandescence usually takes place between 60-120 Km, extinction as low down as 30 Km.

The daily deposit on the earth has been estimated at 10^8 — 10^9 grams of meteoric dust.

The "shooting stars" are pea-sized meteorites. It is estimated that 75 million particles above .12 millimeters in diameter enter the earth's atmosphere every day.

The residue left from meteor evaporation settles slowly down through the atmosphere. This residue may act as condensation nuclei or as catalysts for some of the photo chemical processes which occur in the upper atmosphere and the ionized trails affect radio propagation in the atmosphere.

GASES

Enveloping the solid airborne particles we have mentioned are the atmospheric gases which we will review under the heading of physical properties and the presence of ozone, water vapor, ionized layers and the dynamic forces in the atmosphere.

Constituents

At sea level the constituents of the atmosphere are shown in Table 4.

The principal gases are nitrogen, oxygen, argon and carbon dioxide, all the remainder total about .01%. Water vapor is added to complete the list.

It has been indicated that the relative constituents remain reasonably constant to 150 Km and the lighter elements do not settle out in layers, as might be expected.

We say "reasonably constant" as changes do occur within this region. The percentage of ozone increases to a maximum at about 21 Km and oxygen changes from a molecular form to an atomic form starting at about 80 Km. These effects are both due to solar radiation. The absolute humidity also decreases rapidly and is of very small order above 8 Km, excluding local cloud effects.

In the extreme altitudes other transformations take place. There is evidence for the dissociation of nitrogen into atomic forms. Above 800 Km the atmosphere is about 50% helium and 50% hydrogen. In outer space there is still about one hydrogen particle in each cubic centimeter which, incidentally, produce radio noise.

Molecular weight

The dissociation of oxygen begins at about 80 Km and nitrogen at about 150 Km, due to solar radiation of short wavelength. The effect occurs to a much less extent at lower altitudes as the radiation in the shorter wavelengths has been largely absorbed by the upper atmosphere. Dissociation is not a one-way process. Recombination of oxygen atoms takes place and oxygen and hydrogen atoms may combine to form hydroxyl ions or water.

Constituent		Percent	Molecular weight
Air		100	28.966
Nitrogen	N_2	78.08	28.016
Oxygen	O_2	20.95	32.00
Argon	A	0.93	39,944
Carbon dioxide	CO_2	0.03	44.01
Neon	Ne	0.0018	20.183
Krypton	Kr	0.0001	83.8
Helium	He	0.00053	4.003
Hydrogen	H	0.00005	1.008
Xenon	Xe	0.000008	131.3
Ozone	O_3	0.000001	48.00
Radon	Rn	6×10^{-18}	222
Water vapour		0 to 5%	18.01
Sand, dust, smoke			

Table 4. Constituents of air at sea level.

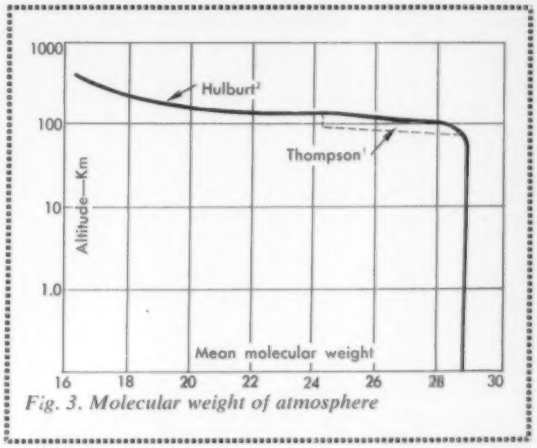


Fig. 3. Molecular weight of atmosphere

The recombination is faster at low altitudes because of the greater density and the shorter path before two atomic particles may collide. At high altitudes, for converse reasons, they do not recombine very rapidly.

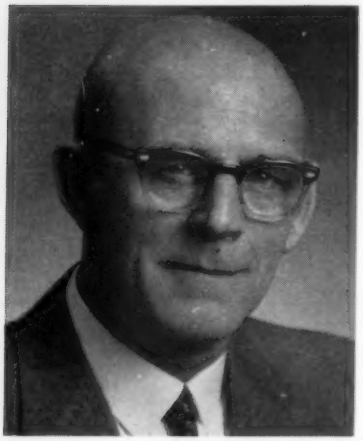
The combined effect of this phenomenon of dissociation is to change the mean molecular weight of the atmosphere as shown in Fig. 3.

This curve drawn, from two sources, shows a constant molecular weight of 28.8 to about 80 Km where an abrupt change takes place leading to a molecular weight of 25 at about 130 Km and decreasing to about 16 at 400 Km.

These changes are significant to investigators in this region, both theoretically and experimentally, as calculations based on classical gas laws must be adjusted accordingly and measurements are affected, particularly where these measurements are not direct but are derived from other measured properties of the atmosphere; e.g. the determination of temperature from measurements of pressure and density.

Part 2 of What's up there? will be published in CEE, November.

Radio engineers and production sharing



Eric L. Palin
Administrative Assistant
Ryerson Institute of Technology
Toronto

General Chairman

The Institute of Radio Engineers Canadian Convention and Exposition has for the past three years provided a showcase for electronics in Canada. The technical sessions have enabled our engineers and scientists to share their knowledge of the latest technological developments, and the exhibits have featured the debut of many new Canadian products.

This year the event takes on an added importance in view of the recently established U. S.-Canadian Defence Production Sharing Program. At this critical time it is vitally important to show our products and potentialities to our American visitors—not only our production facilities, but also our Canadian engineering and scientific achievements, and our research and development progress.

To this end the Electronic Industries Association of Canada has co-operated with the Convention organizers to bring to Toronto a banquet guest speaker who will keynote this new significance—Mr. D. A. Golden, Deputy Minister of Defence Production. Mr. Golden's address will be of vital interest to all concerned with the future of Canadian electronics. Many visitors who can be influential in the success of the integrated production program will be at the banquet. I urge as many members as possible of the engineering, scientific, management, purchasing, sales and other staffs of Canadian electronics firms to attend this important event.

The growing importance of Canadian electronics is also shown by the progress of the Canadian Sections of IRE. Recognition of this growth—to a present membership of over 3,000—has recently been given in our change of name from "Region 8" to "Canadian Region." We shall also be honored by the presence of the directors of IRE, who will hold meetings in Toronto during the Convention.

The technical program contains a wealth of excellent papers, mostly by Canadians. We are, however, very pleased to welcome the contributions of authors from the United States, England and the Netherlands, and trust they will benefit from this international exchange of the news of progress.

Once again the accent will be on quality in the exhibits. This will be recognized in tangible form this year by two Exhibit Awards—one for the outstanding piece of Canadian-designed equipment, and the other for a Canadian component.

The Canadian Region is again inviting to Toronto students from the universities with IRE Student Sections. This is a most important aspect, for these young men—the engineers and executives of tomorrow—will become the builders of both IRE and the industry.

Let us not forget the ladies. Interesting events have been arranged for them and I should like to see as many as possible attend. They are an integral part of a good convention that will be of benefit to the industry as a whole.

This is your Convention—its success will depend on your presence.

Canadian Electronics Engineering's guide to the . . .

1959 IRE Canadian Convention & Exposition

Toronto, October 7-8-9

Here's Canadian Electronics Engineering's Guide to the 1959 IRE Canadian Convention & Exposition. The following pages will help you to get the utmost benefit from this most important event in the electronics industry's calendar.

Basic information about the Convention, including floor plan, list of exhibitors and schedule of technical sessions, is all in this four-page section. Full details of the technical program, the exhibits and new products that will be on display, appear in the following pages.

Spend an hour with our guide and decide how best you can utilize your time at the Convention — the sessions you wish to attend and the booths you wish to visit.

Then tear out this handy summary and bring it with you to Toronto.

See you there!

All you want to know about the 1959 Convention

GENERAL INFORMATION

The Canadian sections of the Institute of Radio Engineers will be host to thousands of engineers, executives, educationalists, technicians and buyers from Canada, the United States and abroad when they present their third annual Convention and Exposition, October 7, 8 and 9.

The three-day program, which is Canada's largest scientific assembly, combines a forum of the latest electronics engineering achievements with a display of the industry's newest products.

Convention centre will again be the Automotive Building at Exhibition Park, Toronto. Located only 10 minutes from the heart of Toronto, this site provides the ultimate in accommodation under one roof. In addition to the 120,000-square-foot exhibit hall, and meeting halls for the presentation of the 25 technical sessions, facilities for delegates and exhibitors will include a complete restaurant service, an industry lounge and ample parking space.

CONVENTION AND EXPOSITION HOURS

Wednesday, October 7th
10.00 a.m. to 6.00 p.m.
Thursday, October 8th
10.00 a.m. to 6.00 p.m.
Friday, October 9th
10.00 a.m. to 8.30 p.m.

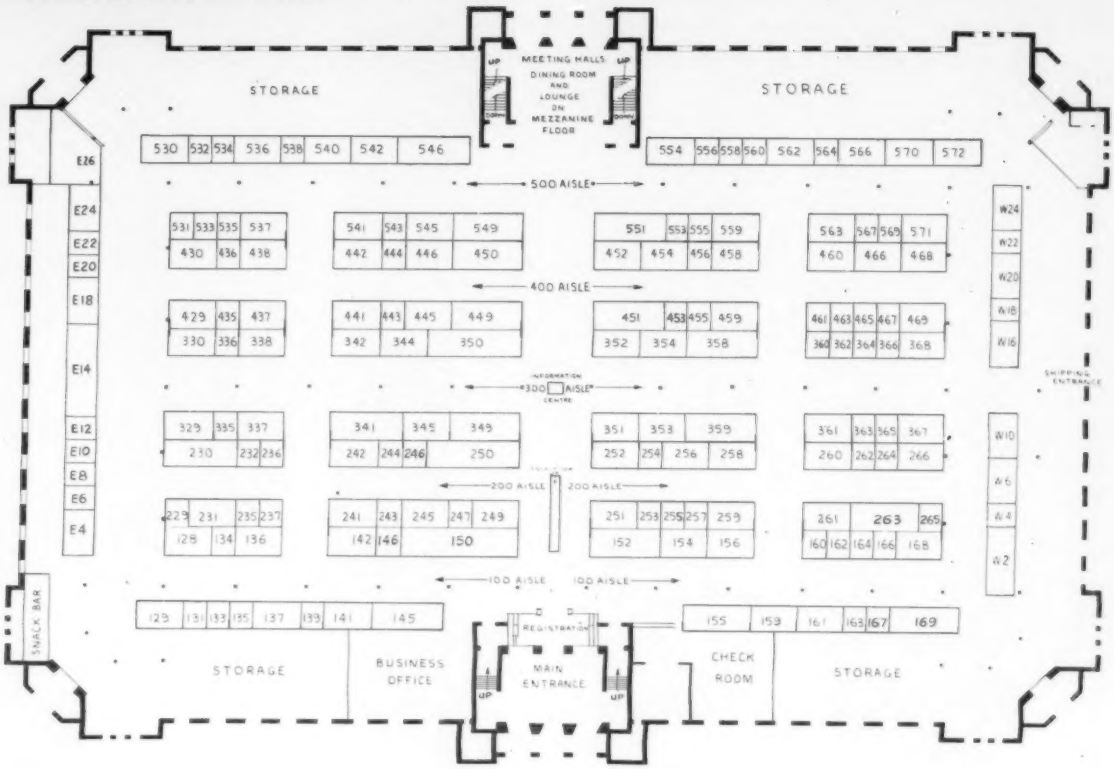
TECHNICAL PROGRAM

Leading engineers and scientists from Canada, the United States, England and the Netherlands will present 107 papers and a panel discussion in 25 technical sessions during the three-day convention. Both practical and theoretical, the papers have been carefully selected by the committee to include the latest information on research, development, design, production, application, management and education in the fields of electronics and nucleonics.

The subject of the panel discussion will be "Recent and projected changes in electrical and electronic engineering curricula at Canadian universities."

(Continued on page 52)

Official Floor Plan



More than 120 exhibitors will be there

Alphabetical list with their booth numbers

Alfax Paper & Engineering Co., Westboro, Mass. 266
American Electrical Heater Co., Detroit, Mich. 558
The American Superior Electric Co. Ltd., Toronto..... 136
Ampex American Corp., Rexdale, Ont. 450
Andrew Antenna Corp. Ltd., Whitby, Ont. 258
A.T.R. Armstrong Ltd., Toronto 342
Astral Electric Co. Ltd., Toronto 338
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Atlas Polar Co. Ltd., Toronto E24
Atlas Radio Corp. Ltd., Toronto 344
Automatic Electric Sales (Canada) Ltd., Toronto ... 559, 563
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Canada Wire & Cable Co. Ltd., Toronto 452
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Canadian General Electric Co. Ltd., Toronto 352
Canadian Marconi Co., Montreal and Toronto
137, 139, 141, 145
Canadian Patents & Development Ltd., Ottawa 345
Canadian Pratt & Whitney Aircraft Co. Ltd., Longueuil
Que. 545
Canadian Radio Technical Planning Board, Toronto ... 131
Canadian Research Institute, Toronto E10
Canadian Westinghouse Co. Ltd., Hamilton 252
Central Scientific Co. of Canada Ltd., Toronto 166
CERL-DALE Ltd., Toronto 260
C. P. Clare Canada Ltd., Downsview, Ont. 246
Collins Radio Co. of Canada Ltd., Toronto 551
Conrad, Inc., Holland, Mich. 244
The Constanta Co. of Canada Ltd., Montreal 146
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Allan Crawford Associates, Willowdale, Ont. 358
George W. Crothers Ltd., Toronto 133

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Edwards High Vacuum (Canada) Ltd., Burlington, Ont. W22
Eitel-McCullough, Inc., San Carlos, Calif. 129
Electro Sonic Supply Co. Ltd., Toronto 159
Electrodesign, Toronto 366
Electromechanical Products, Agincourt, Ont. 562
Electronic Industries Association of Canada, Toronto .. 362
Electronics and Communications, Toronto
(Age Publications Ltd.) 437

Ferranti-Packard Electric Ltd., Toronto 337

General Radio Co., Toronto 152
The Glendon Instrument Co. Ltd., Toronto 335

Hammond Mfg. Co. Ltd., Guelph, Ont. 454
Heinemann Electric Co., Trenton, N.J. 343
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M. J. Howard & Co. Ltd., Ottawa E12
Hysol (Canada) Ltd., Toronto W4

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Instronics Ltd., Stittsville, Ont. 553
International Rectifier of Canada Ltd., Ottawa 461
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Jerrold Electronics (Canada) Ltd., Toronto 443

Kay Electric Co., Pine Brook, N.J. 536A
Keithley Instruments, Inc., Cleveland, Ohio 556
Kester Solder Co. of Canada Ltd., Brantford, Ont. 543

Lake Engineering Co. Ltd., Scarborough, Ont. 436, 438

Masson Seeley & Co. Ltd., Rexdale, Ont. E18, E20
The McBee Co. Ltd., Toronto 329
McCurdy Radio Industries Ltd., Toronto 245
Measurements, a McGraw-Edison Div., Boonton, N.J. .. 555
Mel Sales Ltd., Toronto 534
T. M. Moran & Associates, Toronto 467
Morina Electronics Engineering Co., Toronto 444

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National Semiconductors Ltd., Montreal 134
New Departure Div., General Motors Corp., Bristol, Conn. 254
Northern Electric Co. Ltd., Montreal E14

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Polarad Electronics Corp., Long Island City, N.Y. 530
Potter & Brumfield Canada Ltd., Guelph, Ont. 361
Premier Metal Products Co., New York, N.Y. 330

Prentice-Hall, Inc., Englewood Cliffs, N.J. 463

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Radionics, Ltd., Montreal 451
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Renfrew Electric Co. Ltd., Toronto 231
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Ryerson Institute of Technology, Toronto 469

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Sigma Instruments, Inc., South Braintree, Mass. 341
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Sinclair Radio Laboratories Ltd., Toronto 537
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Sterling Precision Corp., Port Washington, N.Y. 262
Strippit Tool & Machine Ltd., Brampton, Ont. 259
Sylvania Electric (Canada) Ltd., Montreal 458

T.M.C. (Canada) Ltd., Ottawa 242
Tektronix, Inc., Willowdale, Ont. 160
Tele-Radio Systems Ltd., Toronto 155
Tellurometer Canada Ltd., Ottawa 243
Telonic Industries, Inc., Beech Grove, Ind. 232
Texas Instruments, Inc., Dallas, Tex. 359
Thomas & Betts Ltd., Toronto 455
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IRE CANADIAN CONVENTION

1819 Yonge Street, Toronto 7, Ont.
Telephones: HUdson 8-7768 & 1-3331
Grant Smedmore, Convention Manager

Schedule of Technical Sessions

DATE and TIME	ROOMS and SESSIONS				
	Satellite	Transistor	Aeronautics	Pulse	Radar
Wednesday October 7 2.30 p.m. to 5.00 p.m.	1 TRANSISTOR APPLICATIONS	2 INSTRUMENTATION AND CONTROL	3 BROADCAST	4 RELIABILITY IN ELECTRONICS	5 RADAR
Thursday, October 8 10.00 a.m. to 12.30 p.m.	6 STEREOPHONIC BROADCASTING	7 SEMI-CONDUCTORS	8 AIR TRAFFIC CONTROL	9 MEDICAL ELECTRONICS I	10 ANTENNAS I
Thursday, October 8 2.30 p.m. to 5.00 p.m.	11 AUDIO	12 EDUCATION PANEL	13 SOLID STATE ELECTRONICS	14 MOBILE COMMUNICATIONS	15 ANTENNAS II
Friday, October 9 10.00 a.m. to 12.30 p.m.	16 SPACE ELECTRONICS	17 DESIGN METHODS	18 ANALOG COMPUTING	19 MEDICAL ELECTRONICS II	20 COMMUNICATION EQUIPMENT
Friday, October 9 2.30 p.m. to 5.00 p.m.	21 DEVELOPMENTS AT NATIONAL RESEARCH COUNCIL, OTTAWA	22 ENGINEERING MANAGEMENT	23 COMPONENTS FOR DIGITAL COMPUTERS	24 POWER SUPPLIES	25 COMMUNICATION SYSTEMS

All meeting rooms are in the Automotive Building

All you want to know — continued

Other sessions which should be of great interest because of the timeliness of their subjects include: stereophonic broadcasting, air traffic control and space electronics.

EXHIBITS

Electronic and nucleonic displays of the most advanced products and techniques will be presented by over 120 leading manufacturers, distributors and government bodies from Canada, the U. S. and abroad.

REGISTRATION

IRE members and all those engaged in the electronics, nucleonics and associated industries are welcome to attend the convention and exposition. The registration desk will be open during convention hours at the Automotive Building. Registration fee, including technical program and exhibits, is $1. Students of universities and accredited technical schools will be registered without charge on presentation of school registration or student IRE membership cards.

CONVENTION BANQUET

All delegates, exhibitors and their wives are invited to attend this outstanding social event of the Convention. The banquet will be held at the Royal York Hotel on Thursday evening, October 8 at 7.30 p.m. The speaker of the evening will be David A. Golden, Deputy Minister, Department of Defence Production, Ottawa. Mr. Golden will discuss various aspects of the U. S.-Canadian production sharing program. Tickets are $6.

ALL INDUSTRY COCKTAIL PARTY

An opening day "get acquainted" gathering for delegates, visitors and exhibitors. The All Industry Cocktail Party will be held on the mezzanine floor of the Automotive Building on Wednesday, October 7, from 5 to 7 p.m. Price $3 per person.

HOTELS AND TRANSPORTATION

Accommodation for delegates is available at a number of excellent Toronto hotels and motels. Arrangements have been made with Trans-Canada Air Lines to extend reduced fares to delegates and dependent members of their families.

LADIES' ACTIVITIES

The Social Activities Committee has arranged a series of events to ensure an enjoyable convention stay for the wives of delegates and exhibitors. These include a city tour of Toronto, a scenic historical tour to Niagara Falls, Ontario, and a trip to view the Ontario Hydro-Electric Power Commission's model of the St. Lawrence Seaway. The information centre for Ladies' Activities will be located at the Royal York Hotel. Ladies are also cordially invited to attend the Convention Banquet on Thursday evening.

Full technical program and abstracts

Wednesday afternoon, October 7

Session 1 **Satellite Room**

TRANSISTOR APPLICATIONS

Chairman: **G. W. L. Davis**
Ferranti - Packard Electric Ltd., Toronto.

9008 AN AREA GAMMA MONITOR FOR USE IN LOW FIELDS

A. R. Jones, Atomic Energy of Canada Ltd., Chalk River, Ont.

A halogen tube monitor has been developed which covers three decades in one logarithmic scale. The radiation intensity is continuously recorded and a warning light is switched on whenever a chosen level is exceeded. The light remains on until it is reset and serves to draw attention to an abnormal radiation condition during the preceding period, whenever the chart is inspected.

The detector is a halogen counter having a thick chrome iron cathode wall. The counting rate is proportional to the radiation intensity over a wide range of photon energies.

The circuitry is entirely transistorized, containing seven transistors in all. The power requirements, about 1 watt at normal background level, can be met by the mains or batteries.

Rugg

Jones

9058 A TRANSISTORIZED MARINE GYRO COMPASS

H. H. Rugg, Sperry Gyroscope Co. of Canada Ltd., Montreal.

To obtain maximum performance in a minimum of space, newer gyro compasses use electronically amplified control signals sensing earth's rotation and local gravity to cause the gyro to point north. Over-all accuracy requirements impose rather severe demands for gain stability and linearity in the control amplifiers. This paper discusses a transistorized amplifier system developed to replace a vacuum tube system for such a compass, providing desired electrical performance over a wide temperature range, and reducing the physical volume by a factor of at least 4/1. Principles of operation of a gyro compass are discussed briefly to demonstrate the amplifier functions and electrical requirements.

9098 PRECISION AC TRANSISTOR AMPLIFIER FOR INDUSTRIAL CONTROL APPLICATIONS

J. A. I. Young, Canadian General Electric Co. Ltd., Peterborough, Ont.

Many control systems in industry are ac systems, where the signals are in the form of the envelopes of "Suppressed-Carrier" modulated voltages. The carrier amplitude denotes the magnitude of a process variable and the carrier phase indicates the sign of the variable. In simple systems, or sub-systems of more complex systems, several of these signals are summed in a "Summing Amplifier". Vacuum tube summing amplifiers are almost invariably the well known "Operational" type. However, many signal transducers are inherently low-impedance devices and pose problems for operational amplifiers. This paper outlines an approach using a transistor ac amplifier design which capitalizes upon this low source impedance property to provide optimum signal to noise performance, good response characteristics, linear amplification, excellent dynamic range and freedom from drift.

Young

Waugh

9101 A NON-OVERLOADING TRANSISTOR PULSE AMPLIFIER FOR NUCLEONIC APPLICATIONS

John B. S. Waugh, Atomic Energy of Canada Ltd., Chalk River, Ont.

The paper describes a transistor pulse amplifier developed for use with methane proportional flow counters. An introduction summarizes the operation and use of such counters, outlines the counter users' criteria of amplifier performance and formulates an amplifier specification. The problems and relative advantages resulting from the use of either current or voltage modes of operation in the realization of such an amplifier are considered.

An amplifier developed at Chalk River is described in detail and performance data presented.

9112 CASCADED AUTOMATIC GAIN CONTROL

J. S. Brown, General Electric Co., Syracuse, N.Y.

The problems of using agc with transistors are described. An amplifier is described which employs two separate agc loops. The use of two loops results in an amplifier which does not overload at high signal levels and which has a good noise figure at low input levels.

Brown

Simpson

Session 2 **Transistor Room**

INSTRUMENTATION AND CONTROL

Chairman: **George S. Collins**
The Hydro-Electric Power Commission of Ontario, Toronto.

9088 A TEMPERATURE CONTROL FOR A SINGLE - CRYSTAL GROWING FURNACE

J. H. Simpson, National Research Council, Ottawa.

A temperature control for a Czochtalski-type furnace for the growth of single crystals of alkali and silver halides is described. The detecting element is a chromel-alumel thermocouple whose output is compared to a standard dc voltage. The difference is chopped, amplified and demodulated by a transistor amplifier and applied to a thyratron circuit capable of applying 1,000 watts of 60 cps power to a standard resistance heating element surrounding the melt. Some novel features, particularly in the demodulator and output stages, are described.

9055 MACHINE CAPABILITY MEASUREMENT OF A NUMERICALLY CONTROLLED MACHINE TOOL

J. D. Ledoux, Sperry Gyroscope Co. of Canada Ltd., Montreal.

In recent years increasing attention has been given to the use of statistical techniques to establish the performance capability of machine tools. Every machine has inherent variability and a study of the statistical properties of these variations shows that they follow certain basic laws as described by the theory of probability.

Statistical techniques were employed on a turret drill automated with a numerical control. By means of this study, several system faults were detected and corrected which otherwise would not have been found by conventional test methods.

Technical program

Lennox

Jacobson

9040 AN AUTOMATIC GAUGE CONTROLLER FOR THE COLD ROLLING OF STEEL STRIP

B. P. Jacobsen and **D. H. Lennox,** Canadian Westinghouse Co. Ltd., Hamilton.

The various factors which determine the gauge of strip issuing from a cold rolling mill are discussed and illustrated with simplified graphs. By representing certain variable factors by electrical signals, an electrical analog of gauge can be computed and utilized for automatic control. The system developed by Canadian Westinghouse Company from the initial BISRA development is described showing how the deviation from the required gauge is computed from the measurements of load on the work rolls, position of the screws, and required setting of gauge, together with compensations for temperature changes in the mill and variations of oil film thickness in the roll bearings.

9021 A VERSATILE DATA RECORDING UNIT FOR THE ATOMIC POWER DEVELOPMENT LABORATORY

R. S. Flemons, Canadian General Electric Co. Ltd., Peterborough, Ont.

The recording of data in experiments simulating the transfer of heat in an atomic reactor presents interesting problems.

Many diverse quantities must be measured, including pressures, dc voltage and current, ac power, absolute and differential temperatures. More than 30 such variables are recorded on a single 20-point strip-chart potentiometer. The more important quantities are registered every 40 seconds, while others may be as infrequent as every 400 seconds.

A cross-bar switch has been interconnected with a standard multipoint recording potentiometer to provide a versatile instrument capable of easy modification during the progress of experimental work.

The paper outlines the requirements of this field and the characteristics of the major components such as the recording potentiometer and the cross-bar switch. Some details of the programming circuit are described to illustrate how the cross-bar switch can be operated with very few relays. A resumé of the results obtained will be included.

Flemons

Hewton

9131 TRAFFONICS

J. T. Hewton, Municipality of Metropolitan Toronto, Toronto.

The art of designing, or adapting electronic devices for, and applying them to, the special problems of traffic engineering with special reference to current practice and future possibilities in the fields of research, control and enforcement.

Session 3 — **Aeronautics Room**

BROADCAST

Chairman: **R. Horton**
Canadian Broadcasting Corporation, Toronto.

9035 ENVELOPE DELAY MEASUREMENTS IN THE 20 - 100 MC FREQUENCY RANGE

H. Ventser, Northern Electric Co. Ltd., Montreal.

The condition for distortionless fm transmission over radio links for multichannel telephony is that envelope delay of the system be constant, otherwise intermodulation noise and crosstalk between channels will result.

This paper describes a method for measuring envelope delay, using commercially available equipment, to an accuracy of ± 0.25 milli-microseconds for delays around 50 musec.

An amplitude modulated test signal is split and passed through the unit under test and through a standard path. Both signals are demodulated and the phases of the two modulating signals are compared. The phase shift between the two signals serves as an indication of envelope delay.

Grover

Ventser

9014 CBC STUDIOS 7 AND 42 VIDEO AND AUDIO FACILITIES

N. R. Grover, Canadian Broadcasting Corporation, Montreal.

CBC studios 7 and 42, placed into service in Toronto and Montreal respectively in October 1958, represent the Corporation's most recent engineering and operational concepts.

A newly designed video switcher provides for great flexibility in video control together with ease of operation. A new multi-input audio control console with many special features allows the handling of many complex audio set-ups with considerably greater ease than in the past.

Many special features have been provided throughout the studios to aid in the production of large scale TV programs and to simplify operational and maintenance problems in general.

9015 THE USE OF PHASE EQUALIZERS TO IMPROVE THE TRANSIENT RESPONSE OF A TELEVISION TRANSMITTER SYSTEM

J. K. MacDonald, Canadian Broadcasting Corporation, Montreal.

The improvement in transient response and hence of picture quality which was achieved at one of the CBC transmitter installations due to the use of phase equalizers is described.

Basic theory governing amplitude vs. frequency and phase vs. frequency characteristics and their effect on transient response is given as applied to a square wave and to the sine-squared pulse.

The alignment of the station monitor demodulator is described and the type of test equipment used. The techniques of transient testing of the transmitter are described.

Photographs are included of amplitude vs. frequency, differential gain, line rate and field rate window tests on the apparatus as well as of the square wave and sine-squared pulse waveforms through the equipment.

Waveform photographs are included showing the improvement in transient response with the adjustment of the phase equalizers. Photographs of the envelope delay characteristics of the equipment are included. Photographs of the transmitted monoscope picture are included to show the improvement in picture quality with phase equalization.

A recommended test procedure for transient testing is included and a tentative specification for the limits of performance of the station monitor demodulator to a square wave and a sine-squared pulse.

Waters

MacDonald

9013 CBC TELEVISION NETWORK PROGRAM DELAY CENTRE

G. E. Waters, Canadian Broadcasting Corporation, Montreal.

This paper discusses the geographical problems which prompted the CBC at the beginning of 1956, to undertake the project of providing a centre along the coast-to-coast microwave network at which television programs could be delayed and later re-broadcast. Decisions which had to be taken regarding the quantity and layout of the equipment required are discussed, together with the problems attendant upon a double replay at closely spaced intervals.

The performance of the system is assessed, insofar as this is possible with equipment that has been in use barely six months, and mention is briefly made of the staff requirements for such an installation.

9052 AN HF LINEAR AMPLIFIER WITH LOW INTERMODULATION DISTORTION

J. A. Jarvis, Northern Electric Co. Ltd., Belleville, Ont.

A new general purpose hf transmitter is described which has been designed to meet new requirements of low intermodulation distortion and low harmonic output.

The paper reviews the problems of third and higher order distortion products, the use of rf and envelope feedback, and proceeds to describe new approaches which were used to reduce distortion. The relationship of second harmonic generation and third order distortion are discussed.

Jarvis

Marzec

Session 4 — Pulse Room

RELIABILITY IN ELECTRONICS

Chairman: **Allan B. Oxley**
Canadair Ltd., Montreal.

9039 TEST METHODS TO DETERMINE EQUIPMENT RELIABILITY

L. E. Marzec, Canadian Westinghouse Co. Ltd., Hamilton.

Stringent reliability clauses are becoming a more and more common feature of current specifications for military electronic equipment. Previously, the requirements have been very vaguely expressed and in many instances ignored. The onus has now been placed on the supplier to prove to the satisfaction of the customer that the equipment does actually meet the stipulated reliability requirements. This paper outlines some of the statistical methods employed in testing for the required measure of reliability. A short summary is also given of the necessary reliability functions which have to be performed to ensure that the manufactured electronic equipment has a good chance of meeting the reliability requirements specified in the contract.

9005 ENVIRONMENTAL TESTING OF RELAYS TO MIL-R-5757C

J. A. J. Musselman, Canadian Westinghouse Co. Ltd., Hamilton.

All tests required for quality approval are covered, test by test. Various methods, and the instrumentation required, are discussed, and illustrated with slides. Anomalies in the various test paragraphs, and test methods, involving good engineering practice, to overcome these anomalies, are covered where they occur. Special instrumentation developed for monitoring contact chatter and opening during vibration and shock is discussed, and calibration methods of this instrumentation are also covered. Types of failures that occur during individual tests, and possible reasons for these failures, are gone into, especially the intermittent, recurring type of failure, such as contact opening during vibration and shock, that occurs only once during a test.

Musselman

Halio

9003 HOW CAN WE ATTAIN HIGH RELIABILITY OF COMPLEX MILITARY ELECTRONIC EQUIPMENT?

M. Halio, Headquarters, Air Defense Command, U. S. Air Force, Colorado Springs, Colo.

Each piece of military electronic equipment passes through various phases in its normal life cycle. These are planning, design and development, pilot production, manufacture, transportation, storage, operation and maintenance. Each of these stages is replete with opportunities for the introduction of unreliabilities. This paper points out the pitfalls which may be encountered and makes specific recommendations to avoid these so that the full amount of potential reliability may be realized in the final equipment.

9080 RELAY RELIABILITY — A PRODUCT OF DESIGN

R. K. Empey, Automatic Electric (Canada) Ltd., Brockville, Ont.

The second most unreliable component in present electronic equipment — this is the dubious distinction tendered the electro-mechanical device — the relay.

In recent years many articles and papers have been written concerning component reliability and considerable time and money have been spent by research and development laboratories on relay development and modification of design in order to provide relays which will perform required functions with a high degree of reliability.

It is the intention of this paper to outline the problems encountered and the results achieved in the design of a reliable armature-type telephone relay compatible with present day circuitry and components.

Session 5 — Radar Room

RADAR

Chairman: **H. G. Byers**
Canadian Arsenals Ltd., Toronto.

9069 ASPECTS AND PROSPECTS OF MODERN RADAR THEORY

F. E. Howley, RCA Victor Co. Ltd., Montreal.

This exploratory paper examines some of the more fundamental limitations of current radar theory. The various statistical techniques which have been applied to the radar reception problem are reviewed and their relative merits assessed. In particular the Decision Theory approach to radar design is examined in the light of future needs. It is concluded that the incompleteness of information on the statistics of the radar input data is the most important single factor limiting the design of radar systems for optimum performance. To avoid the necessity for basing radar designs on invalid assumptions, the incorporation of "learning" or "adaptive" features in systems is proposed.

Howley

Kuecken

9113 RADAR SYSTEM CALIBRATION THROUGH THE USE OF SOLAR NOISE

J. A. Kuecken, Avco Corp., Cincinnati, Ohio.

The described technique is shown in application to a mobile C-Band height-finding radar. A method is demonstrated whereby the boresight calibration of a radar set in the field may be very accurately checked and errors measured. This is accomplished through the use of solar noise and without the aid of any auxiliary transmitters or electronic equipment. The measurement is simple in nature and may be performed by relatively untrained field personnel. An additional confidence factor is furnished in that the strength of the received signal provides a measure of the over-all system sensitivity including antenna gain.

9004 DELAY - LINE SECONDARY RESPONSES IN AM AND FM SWEEP INTEGRATORS

H. Urkowitz, Philco Corp., Philadelphia, Pa.

A video sweep integrator is a device for adding the successive detected radar returns of successive transmitted pulses. One type of video sweep integrator uses an ultrasonic delay line for storage and the addition is obtained by means of a closed regenerative loop operating continuously with exponential memory. Delay-line secondary, or spurious, responses result from multipath propagation through the delay line. The cumulative effect of these responses after they are recirculated in the sweep integrator may be very significant. The exact effect depends to a certain extent upon the type of modulation that is propagated through the delay line. In this paper the buildup effects of secondaries are determined for both am and fm transmission through the delay line. With am there is a coherent buildup, which results in a secondary buildup relatively much greater than the buildup of the desired signal. With fm it is possible to alleviate the buildup effect of secondaries by introducing a small amount of hum deviation on the carrier frequency, which results in a random buildup. Experiments with fm sweep integrators confirm the expected coherent buildup without hum deviation and also confirm that random buildup occurs when the hum deviation is introduced.

This paper also derives formulas for the effects of delay-line secondaries when the integrator operates with uniform or constant memory for a finite time. In this mode of operation with fm transmission through the delay line, the secondaries build up noncoherently without the introduction of hum deviation.

Technical program

9056 A DIGITAL APPROACH TO RADAR SIMULATION

T. G. Rankin, Sperry Gyroscope Co. of Canada Ltd., Montreal.

This paper describes a digital radar simulator which has been designed to provide military and naval PPI indicators with signals which represent radar targets, jamming and noise. The equipment consists of a number of target generators which compute the absolute position of each target from the course and speed of the target, a computer which calculates the relative position of each target from each simulated radar unit as well as the target signal strength, and radar control units which convert the digital computer output to a suitable radar signal and supplies jamming and noise signal.

Since the target generator and computer are fairly conventional they are described only briefly while the radar controls are given a much more detailed treatment.

Urkowitz

Rankin

Thursday morning, October 8

Session 6 — **Satellite Room**

STEREOPHONIC BROADCASTING

Chairman: **R. H. Tanner**
Northern Electric Co. Ltd., Belleville, Ont.

9134 NEW DIMENSIONS IN SOUND — VIA A SINGLE AM BROADCAST CHANNEL

H. E. Sweeney and **C. W. Baugh, Jr.,** Westinghouse Electric Corp., New York, N.Y.

This new system makes possible the broadcast of two-signal stereophonic sound over a single am channel by simultaneous amplitude and frequency modulation of the carrier.

Transmitter and receiver circuitry are discussed as well as the need for a compensating system to overcome the lack of uniform response in the receiver.

Results of field tests at KDKA confirm laboratory experiments.

9135 A REPORT ON FIELD TESTS OF STEREOPHONIC BROADCASTING BY AM MULTIPLEXING

W. P. Boothroyd, Philco Corp., Philadelphia, Pa.

A proposal for standards for stereophonic broadcasting by compatible am multiplexing is discussed. An analysis of the radiated signal and its main characteristics will be discussed with relation to the requirements on transmitters and receivers. Information on a transmitter multiplexer and a consumer type receiver is included. A summary of equipment installation and field test results of broadcasts from an am transmitter (WABC, New York) completes the paper.

9117 PERFORMANCE CHARACTERISTICS OF FM MULTIPLEX STEREO TRANSMISSION

Boothroyd

Crosby

M. G. Crosby, Crosby Laboratories, Inc., Syosset, N.Y.

The techniques employed in the transmission and reception of fm multiplex stereo, whereby the monaural listener receives a compatible balanced program, will be described. Performance characteristics, based on measurements, will be given which show the signal-to-noise-ratio characteristics obtained with the standards which provide the optimum performance of an fm station as a stereo broadcasting station. These characteristics will be compared to those of the proposed system which utilizes two subcarrier channels, one of which provides stereo information and the other a subsidiary communications channel.

9136 A SYSTEM FOR COMPATIBLE STEREOPHONIC BROADCASTING IN THE AM BROADCAST BAND

J. Avins, RCA Laboratories, Princeton, N.J.

A system for compatible stereophonic broadcasting in the am broadcast band is described. The background leading to the choice of the system and the system parameters is discussed. Both transmitter and receiver problems are considered.

The system has been installed in Station WRCA, New York and field tested from the viewpoint of compatibility and stereo performance. The field test experience obtained has demonstrated a high degree of compatibility and good stereophonic reception on relatively simple receivers.

Avins

Lloyd

9137 THE NATIONAL STEREOPHONIC RADIO COMMITTEE

C. G. Lloyd, Chairman, National Stereophonic Radio Committee, Auburn, N.Y.

This paper will discuss the objectives of the National Stereophonic Radio Committee (NSRC), the manner in which it is organized and the status of its work to date. General information will be given on the types of systems proposed for am, fm and tv stereo broadcasting.

Session 7 — **Transistor Room**

SEMICONDUCTORS

Chairman: **J. R. Whyte**
Radio Valve Co. Ltd., Toronto.

9068 STUDIES ON AVALANCHE BREAKDOWN IN SILICON

P. Webb and R. J. McIntyre, RCA Victor Co. Ltd., Montreal.

A study has been made of voltage breakdown phenomena in diffused silicon junctions. Measurements and observations are reported for the temperature range from 77 to 300 K. The breakdown current at a given applied voltage is carried by a series of random pulses of constant height. The mean pulse lengths are found to increase greatly with decreasing temperatures while the pulse height decreases. The phenomena observed are explained in terms of a model and a mechanism for the switching on and off of a microplasma.

Webb

McIntyre

9106 INFLUENCE OF MINORITY CARRIER RECOMBINATION ON THE CURRENT GAIN OF A MESA TYPE DRIFT TRANSISTOR

D. P. Kennedy, International Business Machines Corp., Poughkeepsie, N.Y.

In transport efficiency calculations using a simplified one-dimensional model, minority carrier spreading within the base region of a transistor is not considered. Frequently the validity of such approximation methods is questioned when applied to devices exhibiting a large current gain. The simplified model eliminates a minority carrier current component parallel to the collector junction face; this elimination is believed to introduce an error in the calculated magnitude of recombination current.

9034 DIFFUSION OF INJECTED CARRIERS IN SILICON

Kennedy

Champness

C. H. Champness, Northern Electric Co. Ltd., Montreal.

The field free diffusion of minority carriers injected at a point into silicon has been studied. The time from injection to the maximum due to the arriving carriers has been measured for various emitter-collector distances. The results do not agree with the conventional solution of the differential equation involving carrier diffusion and life time. There are indications that the effective life time may be a function of the distance from the emitter. This could be the result of enhanced recombination due to a very large concentration of excess carriers at the emitter point during injection.

9067 A NOTE ON THE MODULUS AND PHASE OF THE COMMON-BASE CURRENT GAIN OF THE DRIFT TRANSISTOR

J. M. Stewart, RCA Victor Ltd., Montreal.

The frequency behavior of the modulus and phase of α of the drift transistor is discussed with emphasis on the modulus and phase of α at f_α, the transistor cut-off frequency in the common-base connection. An attempt is also made to explain the dependence of f_α on injection level. Previous work of Almond and McIntyre on the drift transistor has been extended to include the effects of transition capacitance. Provided a constant injection efficiency is assumed, the emitter transition capacitance is seen to be responsible for the dependence of f_α on emitter current; also, at low current levels, it drastically reduces the improvements in cut-off frequency gained by introducing the drift field into the transistor. An interesting result of this investigation is that measurements of f_α against I_e for the drift transistor can lead to accurate determination of both C_{de} and C_{te}, the emitter diffusion and transition capacitances respectively. Up to the present, some doubt has existed as to the best method of determining these parameters and the method proposed may prove to resolve these difficulties.

Williams

Stewart

9143 CYCLOTRON RESONANCE AND NEGATIVE-MASS MEASUREMENT

R. C. Williams, Radio Corporation of America, Princeton, N.J.

Cyclotron resonance in solids will be analyzed from a classical point of view. This analysis yields simple conditions which must be satisfied in order to obtain a resonance.

The valence-band structure of germanium is such that the heavy-hole band contains sufficient negative-mass carriers to be detected by cyclotron resonance. The behavior of the negative-mass carriers undergoing cyclotron resonance will be analyzed by Boltzmann Transport methods.

The evidence for carriers of negative-mass in germanium which was obtained by cyclotron resonance will be presented and discussed.

This work is supported by the United States Air Force Research and Development Command.

Session 8 **Aeronautics Room**

AIR TRAFFIC CONTROL

Chairman: **H. A. Ferris**
Trans-Canada Air Lines, Montreal.

9133 SOME PROBLEMS IN AIR TRAFFIC CONTROL SYSTEMS

O. L. Britney, Department of Transport, Ottawa.

This paper presents some of the results of extensive tests of various Air Traffic Control Systems, conducted by the Department of Transport during the past two years. Particular emphasis is placed on points of contention between different approaches to the air traffic control problem.

9147 DECCA AND AIR TRAFFIC CONTROL

D. J. Underwood, Computing Devices of Canada Ltd., Ottawa.

The present Air Traffic Control system is examined and some current problems are discussed. The philosophy of point source navigation aids is examined against that of area coverage systems, with particular reference to the requirements of varying aircraft types using the air traffic control system. Operational experience with the Decca Navigator System as an aid to air traffic control is described and results of trials of the long range Dectra system and associated data link trials are mentioned.

East

9048 BRIGHT RADAR DISPLAY FOR CANADIAN AIR TRAFFIC

T. W. R. East, Raytheon Canada Ltd., Waterloo, Ont.

A bright display which allows viewing in normal lighting greatly increases the usefulness of radars such as those used for air route surveillance. A radar-to-tv scan converter developed in Canada uses a two-gun recording storage tube in which the information is stored as an electrostatic charge distribution, and displayed on tv monitors at 525 lines, 30 frames per second. RF modulated readout is used to prevent cross-talk between the beams. Dynamic focus on write and read beams allows an over-all resolution of 500 lines. The stored pattern fades at a rate which can be controlled by the operator, so that moving targets leave a trail which shows direction of motion.

9149 OPERATIONAL ASPECTS OF THE FEDERAL AIRWAYS ADMINISTRATION DATA PROCESSING CENTRAL

P. J. Sackson, General Precision Laboratory, Inc., Pleasantville, N.Y.

The air traffic control data processing central is a semi-automatic closed loop control system utilizing automatic data collection, data processing and data display equipment, in conjunction with human controllers to provide for the safe and expeditious flow of air traffic. The system is designed to relieve the controller of the necessity of performing routine air traffic functions, thus providing him with time and the timely information necessary to the exercise of his most important function, that of decision-making and judgment.

This paper contains a brief description of the present problem of air traffic control and a prediction of some of the future problems which will arise as a result of the nation's economic growth and consequent growth of airborne traffic. The system that has been designed to solve the present and future problem is further described by means of a narration of typical air traffic operation. Particular emphasis is given to the automated functions of the system, the equipment necessary to perform the functions and the relationships of the controller to the equipment.

Session 9 **Pulse Room**

MEDICAL ELECTRONICS I

Chairman: **Dr. A. E. Sellers**
University of Toronto, Toronto.

9027 AUTOMATIC RECORDING TECHNIQUES USING THE TELEVISION EYE MARKER

E. Llewellyn-Thomas, M.D., R. Howat, and N. H. Mackworth, M.D., Defence Research Medical Laboratories, Toronto.

Where a man looks and how he searches for visual information when performing various tasks is becoming of increasing importance. This paper describes a method of following the various positions of eye fixation, by the use of a television camera or an ordinary movie camera, viewing the moving corneal reflection or "eye spot." It also describes a method of recording this in-

Llewellyn-Thomas

Howat

Technical program

formation by means of a photocell matrix on a monitor screen and converting the photocell impulses to code for the production of punched tape, suitable for immediate inclusion in a computer program.

9122 SOME APPLICATIONS OF ELECTRONICS: THE CLINICAL DIAGNOSIS OF LESIONS INVOLVING THE EIGHTH CRANIAL NERVE

Dr. W. H. Johnson, St. Michaels Hospital, Toronto.

Abstract not available.

9031 X-RAY PROJECTION MICROSCOPY — APPLICATIONS IN BIOLOGY AND MEDICINE

R. L. de C. H. Saunders and L. Van der Zwan, Dalhousie University, Halifax.

The inherent higher resolving power of X-rays has led to their application to research in microscopy. Primarily magnified images using X-radiation have been obtained by different procedures. Owing to the difficulty of making lenses to focus X-rays, a projection type of X-ray microscope (Cosslett and Nixon) has been developed, which utilizes electro-magnetic lenses to focus the electron beam and to produce a point source of X-rays, which casts an enlarged image of the specimen on to a distant screen or plate. Metallurgical, botanical and entomological studies have been carried out. Recent studies of the peripheral and cerebral vascular systems will be summarized, illustrating the microcirculatory detail obtainable. Exploratory studies of soft and mineralized tissues by X-ray projection microscopy will also be discussed with reference to possible quantitative interpretation.

Cederlund

Saunders

Rotenberg

Johns

9061 BODY SCANNER

J. Cederlund, H. E. Johns and A. D. Rotenberg, Ontario Cancer Institute, Toronto.

In order to try to locate small metastatic nodes, a total body scanner, using a 5 in. diameter x 2 in. high sodium iodide crystal and 5 in. photomultiplier, has been constructed. The crystal is protected from background radiation by a lead shield weighing about 1,500 lb. A focusing collimator ensures that only radiation originating within a very small volume will be registered by the crystal. This detector head is arranged to move in two directions at right angles beneath a prone patient. A synchronously moving plotting unit produces two different pictures of the distribution of the radioactivity within the patient. One is obtained by means of an electrical stylus which produces a mark on a sensitized paper for each pulse. In addition, a light source, the brightness of which is controlled by the counting rate, is arranged to expose a film. The contrast on the film may be altered electronically.

Session 10 — Radar Room

ANTENNAS I

Chairman: **Keith A. MacKinnon**
Consulting Radio Engineer, Ottawa.

9146 LOG PERIODIC ANTENNAS

R. H. DuHamel, Collins Radio Co., Cedar Rapids, Iowa.

A brief review is given of log periodic design principles and of various types of log periodic antennas. The variation of the radiation patterns, input impedance, and phase centre with the design parameters is described for a typical structure. Various applications are mentioned and some current research programs are discussed.

Sinclair

DuHamel

9084 THE DESIGN OF OMNIDIRECTIONAL RING ARRAYS

George Sinclair, University of Toronto, Toronto.

A study has been made of design procedures for ring arrays suitable for high power broadcast stations. Special attention has been paid to arrays having a large number of elements, and design data has been obtained using a high-speed computer.

9066 AN ANTENNA DECOUPLER

W. V. Tilston, Sinclair Radio Laboratories Ltd., Toronto.

Whenever two separate communication systems are used, there is a certain amount of mutual coupling between them. This coupling depends on the antenna type, orientation, and spacing.

For reasons of economy, it is often desirable to mount the two antenna systems colinearly on the same tower. The disadvantage of this is that the lower antenna usually has much less coverage than the higher one. To overcome this, a method has been devised and tested, by which the two antennas may be placed much closer to one another, while still maintaining the coupling at a very low value.

Tilston

Tomcio

9138 TV TRANSMITTING ANTENNAS AS BANDPASS TRANSDUCERS

N. Tomcio, Canadian General Electric Co. Ltd., Toronto.

A tv transmitting antenna resembles in many respects a bandpass transducer. Its performance can be described by three major characteristics: radiation, impedance, transient.

This paper discusses the antenna performance from the point of view of frequency response and the effect of the antenna characteristics on the tv signal distortion. Various types of radiators (batwing, slotted cylinder and helix), and different feed system configurations (parallel, cascade, resonant and non-resonant) are considered.

In view of the effect of the radiating system characteristics on the signal quality, the need for the establishment of satisfactory tv antenna performance standards is pointed out.

9105 BROADSIDE ARRAYS OF LONG-YAGIS

D. L. Sengupta, D. D. Y. Tang and J. L. Yen, University of Toronto, Toronto.

The long-yagi is a very simple low-cost end-fire antenna capable of narrow beam operation. However, due to the structural limit of maximum length attainable in practice, there is a limit in beam width or gain. To achieve much narrower beam width, the long-yagis can be used as elements in a broadside array. The design aspects, some experimental results, and finally, the advantages of such arrays are presented. They are most suitable in the uhf range because of the dimensions involved. The investigation was motivated by the feasibility study of very large arrays for high resolution radio astronomical observations. Moderate sized long-yagi arrays should compete favorably with parabolic reflectors in the uhf range for many other applications.

Tang

Yen

All meeting rooms

are in the

Automotive Building

Thursday afternoon, October 8

Session 11 — **Satellite Room**

AUDIO

Chairman: **V. L. Henderson**
University of Toronto, Toronto.

9051 VARIABLE GAIN AMPLIFIER

D. G. Vice, Northern Electric Co. Ltd., Belleville, Ont.

Variable gain amplifiers as compressors and limiters have found wide application where overload of circuits due to rise in signal input level or excessive peaks in dynamic range of input level are to be prevented.

In addition to a discussion of design objectives and limitations encountered in a variable gain amplifier for use in high quality audio applications, this paper also describes a new variable gain device, the expander-compressor, which is capable of giving considerable signal to noise improvement as subjectively measured, on speech or program signal.

The paper will be accompanied by a demonstration of the effects of these devices on program material.

Vice

deBuda

9097 THE DISTORTION DUE TO THE USE OF CENTRE TAPPED TRANSFORMERS IN A CLASS B POWER AMPLIFIER

R. G. deBuda, Canadian General Electric Co. Ltd., Toronto.

The transformer-coupled class B amplifier is investigated with regard to even harmonic distortion and over-voltage effects caused by the use of a centre tapped transformer. A detailed study of the circuit shows which characteristics are required of the transformer to achieve acceptable distortion levels in the amplifier. The interdependence of low frequency response, stray capacitance, leakage inductance and voltage rating is discussed in demonstrating the compromises necessary to achieve a good yet realistic transformer specification.

9010 TECHNIQUES AND INSTRUMENTATION FOR ACOUSTIC MEASUREMENTS

J. B. Harris, Radio Speakers (Canada) Ltd., Toronto.

This paper concerns the transmission of sound in a gaseous medium, and the effects of obstructions on a plane sound wave. Types of meters for sound pressure measurement and allied measurements are described and the effect of various rectification circuits considered. A multi-tone calibration system is outlined. The effect of various sizes and shapes of baffles on loudspeaker response curves is described. A suggested method of specifying the over-all efficiency of a loudspeaker which takes into account the conversion efficiency, distortion, directivity and power handling ability is advanced.

9064 THE ACOUSTICS OF SMALL ROOMS

J. R. Richardson, Sinclair Radio Laboratories Ltd., Toronto.

The fundamental resonances of small rooms lie in the lower region of the audible range and are therefore predominant in the acoustical properties of such enclosures. Both the steady-state and transient-state behavior of a rectangular enclosure with varying boundary values is considered and results which show the variations in decay form and decay time under different conditions are given.

Session 12 — **Transistor Room**

EDUCATION

Chairman: **Prof. J. W. Porteous**
University of Alberta, Edmonton.

PANEL DISCUSSION ON ENGINEERING CURRICULA

Prominent Canadian educators will discuss recent and projected changes in electrical and electronic engineering curricula at Canadian universities. The chairman is also chairman of IRE's Canadian Region Education Committee.

The educator's stand will undoubtedly be based on the belief that, because there have been many significant changes and many areas opened up in the last few years (dominantly solid state physics), therefore the engineer must understand a wider variety of physical phenomena. Curricula must be designed so that the engineer is in a better position to understand what the physicist has done.

This raises three main areas of question:

(1) How broad a scientific basis does today's electrical engineer need?
(2) What is the end objective of an engineering curriculum?
(3) Where can we reasonably hope to be at the end of four years?

The panel will open by tabling changes which are now in effect at their own universities. They will also discuss those changes which are projected for the immediate future.

Panel Members:
Dr. J. W. Hodgins, Dean of Engineering, McMaster University, Hamilton.
Prof. A. D. Moore, Dept. of Electrical Engineering, University of British Columbia, Vancouver.
Dr. G. L. d'Ombrain, Dept of Electrical Engineering, McGill University, Montreal.
Prof. G. R. Slemon, Dept. of Electrical Engineering, University of Toronto, Toronto.

Session 13 — **Aeronautics Room**

SOLID STATE ELECTRONICS

Chairman: **Dr. S. N. Kalra**
National Research Council, Ottawa.

9118 THE PROPERTIES OF METALS AT LOW TEMPERATURES

A. C. H. Hallett, University of Toronto, Toronto.

A review will be given of the experimentally determined electrical and magnetic properties of metals at low temperatures including such phenomena as superconductivity and resistance anomalies. The fundamental processes which occur in metals to produce the observed behavior will be discussed briefly.

Richardson

Sziklai

9144 MOLECULAR ELECTRONICS

G. C. Sziklai, Westinghouse Electric Corp., Pittsburgh, Pa.

The Molecular System Engineering concept provides a revolutionary new method of electronic system fabrication and design. The new system is built by topology of material domains rather than by the arrangement of components. The molecular system concept provides great savings in size, weight, and power consumption, as well as a high degree of reliability, and promises to stimulate the invention of new systems.

The Molectronics approach of system design provides a direct interchange of knowledge of structure of matter and modern system logic. With this new approach, subsystems have been designed and built in monolithic form, proving the practical value of Molectronics.

9087 FUEL CELLS — A "STATE OF THE ART" SURVEY PAPER

E. L. R. Webb and R. R. Jackson, National Research Council, Ottawa.

Fuel cells, i.e., electrochemical converters of combustion energy to electrical energy, have been studied for 120 years. In recent times, concentrated effort has been directed to the production of practical fuel cells, and it appears that they will be commercially available in the fairly near future. The paper gives a brief historical outline, a discussion of the operating principles of existing types and some economic and physical parameters of the hydrogen-oxygen cell.

9145 TUTORIAL PAPER ON MASERS

G. A. Woonton, McGill University, Montreal.

The name Maser, coined in 1955 by Prof. C. H. Townes of Columbia University, is made up of the initial letters of the following phrase which is descriptive of the device: Microwave Amplification by Stimulated Emission of Radiation.

The maser takes advantage of the fact that atoms or molecules may exist in several energy states. Exposure to an electromagnetic field may stimulate transitions between these states with an accompanying absorption or emission of electromagnetic energy. It is part of the maser technique to arrange that the net effect is emission with the result that the stimulating radiation is amplified.

Technical program

Session 14 **Pulse Room**

MOBILE COMMUNICATIONS

Chairman: **Prof. J. E. Reid**
University of Toronto, Toronto.

9140 GROWTH OF MOBILE COMMUNICATIONS IN THE UNITED STATES

C. B. Plummer, Federal Communications Commission, Washington, D.C.

The rapid growth of land mobile radio use in the United States has required a reappraisal of the distribution of frequencies among the various users in order to meet the requirements for continued expansion. Channel splitting has provided an opportunity to appreciably expand the number of frequencies available for rapidly growing uses while, at the same time, uses that had reached apparent maturity in their growth cycle were only moderately expanded. Eligibility for use of a particular group of frequencies has been changed from a single eligibility policy to a multiple eligibility policy in order to accommodate multiple business users and simultaneously increase efficiency of frequency utilization.

9116 SEAWAY COMMUNICATION SYSTEM

J. E. Coke, The St. Lawrence Seaway Authority, Cornwall, Ont.

There are two communication systems in use on the St. Lawrence Seaway; a conventional land line telephone service for point-to-point communication, and a marine radio telephone system for ship-to-shore vessel despatching. The history and development of both these systems will be given, starting from the magneto telephone system in use on the old canals to the installation just completed.

An am and an fm radio telephone service are presently in use. This is only a temporary condition, as it is anticipated that once the navigators see the advantages of fm, all ships will be so fitted thus making all communications for canal despatching in the future fm only.

Barnes

Plummer

9119 TRANSISTORIZED PROGRESS LINE SYSTEMS

J. M. Barnes, General Electric Co., Lynchburg, Va.

A brief history of the transistor in mobile equipment will be presented and the reasoning behind the decision to design a new and radically different mobile system will be discussed. Receiver and transmitter circuitry will be presented briefly and the interelated necessity for thermal isolation and vehicle mounting compatibility will be explained. The system interconnections will be presented. Emphasis will be placed on the portions of the circuitry which are radically different from conventional circuitry. The main factors which concern the lack of necessity for constant temperature crystal ovens and the incredibly low standby drain (.040 amp) will be discussed. In summation, a comparison will be made between Progress Line and a conventional tubed mobile combination.

9142 A NEW CANADIAN DESIGN OF VHF MOBILE COMMUNICATIONS EQUIPMENT

W. Ornstein, International Systcoms Ltd., Montreal.

An unusually compact mobile radiotelephone design having a power rating of 10 or 30 watts is described. The unit incorporates transmitter, receiver, operating controls and loudspeaker in a single aluminum alloy case. Total weight is less than twelve pounds. The unit is small enough for underdash mounting in a modern passenger car. The transistor power supply is in a separate case designed to be mounted on the vehicle firewall. Heater voltage regulation is employed to minimize vacuum tube reliability. Careful attention to thermal design has minimized the development of hot spots in the interior of the equipment.

Session 15 **Radar Room**

ANTENNAS II

Chairman: **M. Katchky**
Canadian Arsenals Ltd., Toronto.

Cairns

9095 RESISTIVELY TERMINATED SPIRAL ANTENNA

F. V. Cairns, National Research Council, Ottawa.

Many of the characteristics of double archimedes spiral antennas have been known for some time. However, since this information is not readily available in the literature a brief description and a simplified theory of operation of spiral antennas is justified by this simple theory. Details of some spiral antennas and measured results showing the improvement in the effectivenes of the spiral antenna as a broad band receiving antenna as a result of the resistance termination are presented.

9053 A DUAL REFLECTION MICROWAVE ANTENNA

E. S. Kelsey, Northern Electric Co. Ltd., Montreal.

The antenna described in this paper consists of two singly curved parabolic reflectors and a feed horn or equivalent point source. The first reflector converts the spherical waves originating from the point source into cylindrical waves and the second reflector converts the cylindrical waves into plane waves. Singly curved parabolic surfaces have the advantage over a paraboloidal dish that they can be formed from plane sheets. Also, the supporting structure can consist of straight members in one direction and of identical parabolic curved ribs at right angles thereto.

9063 DUPLEXER OPERATOR IN A TX-RX SYSTEM AT 950 MC

W. V. Tilston and J. R. Richardson, Sinclair Radio Laboratories Ltd., Toronto.

A duplexer which permits the simultaneous operation of a transmitter and receiver on a single antenna in the 900-1,000 mc band has ben constructed from sections of waveguide. Satisfactory operation is possible with a transmitter power of 1 kw and separations between the transmit and receive frequencies of 5 mc or more, tuning to any given pair of frequencies being possible by means of adjustable posts. The development and operation of the duplexer and its performance with respect to frequency separation, isolation between the transmitter and receiver, insertion loss and bandwidth, are described.

9139 THE OUTER IONOSPHERE AS A TRAVELING WAVE TUBE

R. E. Barrington, Defence Research Board, Ottawa.

The whistler mode of propagation is such that the phase velocity of the waves is very much less than the velocity of light. Hence, for whistler frequencies, the outer ionosphere may be considered as a giant slow wave circuit which guides the waves along a line of force.

At times of solar disturbances and magnetic storms, streams of ions are thought to be precipitated into the earth's ionosphere along the lines of force of the earth's magnetic field. Their velocity is estimated to be of the same order as the whistler phase velocity and thus the interactions of these ion streams with the earth's ionosphere may be described in terms of traveling wave tube theory.

Some of the results of an investigation to determine if such a mechanism can be responsible for the naturally occurring low frequency emissions associated with magnetic disturbances, will be presented.

Barrington

Steele

9094 MICROWAVE ANTENNA COUPLERS FOR COMPARATIVE LOSS MEASUREMENTS

K. A. Steele, National Research Council, Ottawa.

An antenna coupler is used as a coupling device for making comparative loss measurements on microwave transmission systems terminated by antennas having similar near-field radiation pat-

terns. By making the coupler nearly reflectionless, it can be placed very close to the aperture of the antenna under test without the usual effects of mutual reflections. Design requirements are discussed and the perfromance of broadband couplers for L-band and K_u-band is given.

See us at Booth 460

Friday morning, October 9

Session 16 **Satellite Room**

SPACE ELECTRONICS

Chairman: **Dr. P. A. Lapp**
The de Havilland Aircraft of Canada Ltd., Downsview, Ont.

9127 A DISCUSSION OF SPACE EXPLORATION PLANS

N. D. Sanders, National Aeronautics and Space Administration, Washington, D.C.

The goals of the civilian space exploration program of the United States are discussed and plans for communications satellites are described in some detail. Some of the major problems confronting the space exploration program are considered.

Sanders

Brown

9128 SPACE INSTRUMENTATION

R. K. Brown, Defence Research Board, Ottawa.

This paper reviews briefly the ionospheric investigations which have been a part of the program of the Defence Research Telecommunications Establishment in Ottawa.

The author points out some of the limitations of measurements of the ionosphere made from the surface of the earth and indicates that it would be desirable to make measurements within and from above the ionosphere.

Two experimental programs are described. The first makes use of rocket-borne equipment to measure the electron density within the ionosphere. The second experiment is designed to make measurements of the ionosphere from above using equipment carried in a satellite.

The rockets and the rocket vehicle which will be used to put the satellite in orbit are being supplied by the National Aeronautics and Space Administration of the United States.

9111 LUNAR SPACE COMMUNICATIONS

T. A. Randell, Westinghouse Astronautics Institute, Baltimore, Md.

The paper concerns system parameters and concepts for lunar communications between the earth and the lunar surface and lunar vehicles in transit.

Three major requirements will be considered:

(1) Speech transmission
(2) Code
(3) Wide band tv type transmissions.

Various important system configurations are derived which arise from the need to achieve an extremely long range with a minimum of power. The effects of beamwidth and doppler frequency shifts are important in deriving the optimum pass band for each type of transmission.

Various vehicle characteristics which affect the communication system are discussed which will have a strong influence on the type of communication system likely to be employed.

Randell

9130 SPACE MISSIONS OF THE NEAR FUTURE

A. E. Maine, The Canadian Astronautical Society, Downsview, Ont.

Since the time of Verne, and indeed earlier, authors of both serious and fictional works have described space missions and vehicles based either on pure imagination or at the best conjecture. Over the course of the last few years this situation has changed and it is now possible to peer into the near future with considerably more assurance in regard to man's new generation of spaceships and missions. Gone are the days of sleek torpedo shaped rockets complete with rows of portholes and, for that matter, many of the bizarre devices reminiscent of sections of oil refineries in free orbit. Such pictures have been replaced by the missions already announced by NASA and ARPA and we see a reasoned and systematic extrapolation of what might be called the "big-missile" art. Clearing the fog from the area of impending space developments has been due to a larger number of individuals, notable among these being K. Von Erich of Convair. This paper draws on recently released information concerning the United States Space Program and, commencing with the Atlas missile in its astronautical roles, outlines what we may reasonably expect to take place over the next twenty years or so. Naturally many things can change in a period such as this and some of the predictions might well turn out to be in error . . . nonetheless what is presented represents a careful summary of the considerations of many true contributors and experts in the field of astronautics.

Session 17 **Transistor Room**

DESIGN METHODS

Chairman: **Prof. J. H. Blackwell**
University of Western Ontario, London, Ont.

9073 A NEW GRAPHICAL DESIGN PROCEDURE FOR LC FILTERS

L. Slaven, RCA Victor Co. Ltd., Montreal.

The basic transmission equation of the Zobel type filter is analyzed. This equation is then utilized in deriving the set of relationships necessary for the construction of a graphical procedure for the design of these filters.

Its use in the design of "dissipationless" low pass, high pass and band pass filters is illustrated.

Another application discussed is the use of this method in determining the optimum design parameters of a tone channel multiplex system. It is shown that the determination of maximum obtainable bandwidth, maximum adjacent channel rejection, and optimum channel spacing for a given filter structure can be easily determined by this method.

The conditions necessary for adding a given number of channels to an existing system are also considered.

Finally, the effects of dissipation, reflection loss, and interaction loss in practical filters are discussed. Methods for allowing for this effect are illustrated.

Slaven

Bates

9025 INTERPRETING MEASURED POWER SPECTRA OF SHORT SAMPLES OF TIME SERIES

R. H. T. Bates, Canadian Westinghouse Co. Ltd., Hamilton.

It is shown that the power spectra of short samples of time series are distorted from long-term values in two largely independent ways. The fluctuations in the average powers of the samples increase with decreasing sample length. The distortion in the shape of the spectra increases with decreasing sample length. From a consideration of the autocorrelation function of a sample a simple method of estimating the long-term spectrum is derived. The method suffers from being inductive, but the direct approach

is hindered by analytical difficulties and appears to be too complicated for practical use.

9006 THE ANALYSIS OF THE OPERATING POINT INSTABILITY OF ELECTRONIC DEVICES

B. A. Bowen, Royal Military College of Canada, Kingston, Ont.

This paper presents a formal method of analyzing a device to determine the variations in operating point which would be caused by changes in various influencing parameters. A general functional relation is expanded as a partial differential equation. This stability (or instability) equation has terms which depend upon circuit environment of the device as well as the independent parameters causing the instability. It is shown that a particular device can be analyzed to provide the terms for the stability equation, which can then be integrated to determine the total change in bias over the range of interest. Several definitions are postulated which tend to clarify the use of such terms as "stability," "stability factor" and "stabilization."

To illustrate the theory, experimental results are presented to show the effects of temperature and power supply ripple on transistor amplifiers employing single- and double-stage stabilization.

Bowen

Barsony

9082 STABLE HORIZONTAL MULTIVIBRATOR OSCILLATOR DESIGN BY GRAPHICAL METHODS

C. L. Barsony, Dominion Electrohome Industries Ltd., Kitchener, Ont.

This paper describes a graphical method for determination of horizontal multivibrator oscillator stability. The causes of various effects such as "mode-hopping," "back-locking" and "frequency shifting" are discussed and described by graphs of the oscillator transfer function. Using the transfer function as an index of oscillator stability, it can be determined what effect component variation, tube cut-off voltages, frequency corrective measures, and pull-in range unbalance as well as horizontal afc system damping will have on oscillator stability. Optimum methods for adjustment of oscillator frequency are discussed.

9104 UHF PARAMETRIC AMPLIFIERS

S. Dmitrevsky and J. L. Yen, University of Toronto, Toronto.

This paper describes the development work on parametric amplifiers at the University of Toronto. One result of this program is a 320 mc amplifier for radio astronomical observations. After a brief review of the basis of parametric amplification the analysis of amplifier performance is given. Problems encountered in the design of devices of this type in both the uhf and the vhf region are described. Detailed experimental investigation of the effects of various circuit parameters on amplifier performance is then presented. Finally, the design and operation performance of a three cavity amplifier for the 320 mc radiometer of David Dunlap Observatory is given.

Session 18 — Aeronautics Room

ANALOG COMPUTING

Chairman: **Dr. J. M. Ham**
University of Toronto, Toronto.

9059 AN ELECTRONIC SWITCHING MATRIX

P. T. Caden, Sperry Gyroscope Co. of Canada Ltd., Montreal.

This paper describes a high-speed electronic commutator, or switching matrix, intended to be used for switching dc analog signals in a data gathering system. The design of this commutator was directed toward reduced setting errors, scale errors, cross talk, and gating pulse energy. In the conventional diode bridge electronic switch, some of these requirements are considered to be mutually exclusive.

The design and construction of a high-speed switching matrix consisting of 64 transistorized modular commutator elements is discussed, and sources of error are considered in detail.

Glinski

Caden

9033 ANALOG MULTIPLIER UTILIZING HALL EFFECT

George S. Glinski and Charles H. Le May, University of Ottawa, Ottawa.

In recent years, the availability of semiconductor materials with large Hall constant renewed the interest in the utilization of the Hall effect for economical and accurate analog electronic multiplication.

After a brief introduction to physics of the Hall effect, this paper discusses several second order effects complicating the design of a practical Hall effect multiplier. Some of these effects have their origin in the characteristics of the Hall effect semiconductor itself (magnetoresistance, temperature dependence, resistive and inductive coupling, etc.), and some are due to the other necessary components (nonlinearity of core material producing the magnetic flux density, frequency dependence of magnetizing current, etc.)

Practical compensating means for the elimination of these undesirable secondary effects are suggested and supported by the experimental results.

9108 A PULSE POSITION MODULATION ANALOG COMPUTER

E. V. Bohn, University of British Columbia, Vancouver, B.C.

An important field of application for computers is in real-time system simulation. This requires the generation of nonlinear functions, obtaining the sums and products of these functions and solving systems of nonlinear differential equations. A new type of analog computer suitable for systems simulation is described which combines the desirable features of the digital and analog computers in its mode of operation. Variables are represented by the time interval between pulses. Utilizing a few basic components it is possible to carry out the operations of addition, subtraction, multiplication and function generation to 0.1% accuracy.

Bohn

Moore

9042 A POLYNOMIAL COMPUTER FOR SYSTEM FUNCTIONS

A. D. Moore, F. A. Ruegg and E. W. Scratchley, University of British Columbia, Vancouver, B.C.

A analog computer for factorizing algebraic polynomials, representing rational system functions, and generating periodic waveforms, is described. Intended for use in the analysis and synthesis of communications networks or control systems, the instrument is believed to be more versatile than other similar devices. Using resolvers as electromechanical phase-shifters in a carrier system, two polynomials of degree up to 10 can be represented simultaneously for system-function studies. For polynomial factorization, provision is made for complex co-efficients, or for cascading the two channels to handle polynomials of higher than the tenth degree.

The same instrument can be used for Fourier synthesis. Test results indicate that the instrument can determine the zeros of polynomials to two significant figures under favorable conditions.

9107 A FEED-BACK METHOD FOR OBTAINING A SYNCHRO OUTPUT SIGNAL PROPORTIONAL TO INPUT ANGLE θ FOR LARGE θ

M. B. Broughton, Ste. Foy, Que.

The ac output signal from the cosine terminal of a Scott-connected transformer attached to the outputs of a three-phase synchro transmitter is fed back through an amplifier of suitable gain to provide a signal at the sine terminal of the Scott-connected transformer which is proportional to the rotor rotation for angles of up to 90 deg or greater. For example: if the region of θ is $\pm$ 90 deg, the deviation from linearity of θ, $\frac{\text{Sin } \theta}{a + b \text{ Cos } \theta}$ can be kept within 0.005 by proper choice of a and b. The constants a and b and the deviation from linearity are in general functions of θ_{max}.

MEDICAL ELECTRONICS II

Chairman: **Group Capt. B. R. Brown**
Royal Canadian Air Force, Ottawa.

9028 AN ULTRA-LOW-FREQUENCY ANALYZING SYSTEM

J. F. Davis, H. A. Ferris and H. A. Kolshorn, Royal Victoria Hospital, Montreal.

The electrical potential in the gastro-intestinal tract varies with a number of physiological factors including chemical, mechanical, metabolic and others. The spectral distribution of these variations, distinguishable from noise, covers the range from 4 minutes per cycle to 0.5 cycles per second. The wave forms, registered by a dc amplifier and recording system, are transferred to a magnetic tape loop using a novel twin-carrier modulation technique, which is relatively independent of tape variations and speed perturbations, resulting in an economical tape transport mechanism, operating at 1/32 inch per second.

Demodulation is carried out at a tape speed of 7½ inches per second (translation ratio of 240:1), giving a new spectral distribution of 1 cps to 100 cps. The analyzer writes out the average amplitude for each of 20 different frequency bands in this range. A 20-minute sample of original recording thus takes 5 seconds of playback time. The frequency profiles obtained in this way are more amenable to statistical analysis than are measurements made on the raw data. Some clinical results will be discussed.

Broughton

Sekelj

9047 AUTOMATIC COMPUTING OXIMETER

P. Sekelj, The Montreal Children's Hospital, Montreal.

The unit to be described was developed as a joint project of the Department of Physiology, McGill University and the Department of Biophysics of the Montreal Children's Hospital. It has been designed for automatic computation and recording of the absolute value of oxygen saturation in man.

The principles upon which the operation of this instrument is based have been reported earlier. With the instruments described by us in the past the photoelectric signals picked up by the earpiece were recorded on a two-beam galvanometer and converted into absolute values of oxygen saturation by means of a manually operated calculator. In the present instrument the photoelectric signals are modified in an appropriate manner and fed into an electronic computer. The absolute value of the oxygen saturation is read off the scale of a vacuum tube voltmeter and may be continuously recorded by a pen recorder.

This instrument has provided trouble free operation for over three years. It is considered as an essential part of the routine catheterization equipment and has been extensively used on various research projects.

Roy

Custance

9091 AN ELECTRONIC DEVICE FOR THE CONTINUOUS MEASUREMENT OF SWEAT RATE

O. Z. Roy, National Research Council, and **A. C. Custance, M.D.,** Defence Research Board, Ottawa.

In the determination of physiological stress, sweat rate appears to be one of the most reliable indexes. An instrument for the continuous and automatic measurement and recording of this by a novel technique will be described.

A humidity-sensing element is mounted in a small chamber against the skin in such a way that the atmosphere within it can be held to a given relative humidity by controlled flushing with dry air. The amount of air required at any given moment is a reflection of the sweat rate.

A servomechanism has been designed to regulate and record this flow of air across the element.

9121 THE DESIGN AND USE OF A COPPER MAN FOR CLOTHING INSULATION ASSESSMENT

Flt.-Lt. D. J. G. Soper and F.O. C. L. Allen, Royal Canadian Air Force, Toronto.

An artificial copper man which has been designed and built by the RCAF is described. The "man" is essentially a calorimeter fashioned in the shape of a human body with articulating joints. Fourteen separate electrical circuits are employed to supply heat to the various segments of the man whose skin temperature is measured with thermocouples. The power required to maintain a steady skin temperature under cold ambient conditions is a measure of the thermal efficiency of the clothing in which the man is dressed. The advantages of this device as a laboratory tool and its proper use in a clothing development program are discussed.

9123 CENTRALIZED SURGICAL MONITOR SYSTEMS

M. J. Fischer, Epsco, Inc., Worcester, Mass.

Some of the oldest applications of electronics have been in medicine. The first electrocardiogram was made in 1887. Use of electronic diagnostic equipment has been greatly stimulated by World War II and postwar developments.

The discovery of the effect of anesthetic agents on brain waves opened up the field of electronic surgical monitoring. Estimation of patient's condition previously depended on evaluation of surface clinical signs. Advanced surgery, such as cardiac repair, requires much closer control. First monitoring instruments were miscellaneous equipment mostly intended for other purposes. Centralized surgical monitor systems are described. They concentrate equipment in a central control room, thereby reducing clutter in operating rooms, create no contamination or fire hazard and provide 100% monitoring of operating suite.

COMMUNICATION EQUIPMENT

Chairman: **C. Webster**
Canadian National Telegraphs, Toronto.

9114 COMMUNICATION NETWORKS FOR INTEGRATED DATA PROCESSING

J. M. Unk, Philips Telecommunication Industries, Hilversum, Netherlands.

A high speed communication network capable of transmitting digital information from many "user" centres to a central computer, and vice-versa, has been designed and produced by Philips Telecommunication Industries. In the design of the communication network, emphasis has been placed on three main requirements: reliability of operation, speed of transmission, and efficient utilization of transmission equipment.

A system capable of transmitting three priorities of messages at a rate of 1,000 bauds (1333 words per minute) between many widely separated stations is discussed.

Future communication networks for data handling which have a transmission and handling speed of 2,400 bauds and up are also described.

Applications of the system to inventory, reservations, and accounting problems are outlined.

Unk

Yeats

9049 A NEW 11 KMC RADIO SYSTEM

J. E. A. Yeats, Northern Electric Co. Ltd., Montreal.

TJ radio is designed for short-haul line-of-sight microwave transmission of television, multiplex telephony, or other broadband communication signals.

The system operates in the common carrier band between 10,700 and 11,700 megacycles — a frequency range where rainfall absorption and multipath fading are particularly significant in the determination of radio channel loading, system length and repeater spacing.

System features include frequency diversity protection against multipath fading and equipment failure, and a remodulating type of repeater which reduces the fm radio signals to baseband so that video and message circuits may be inserted or dropped at each repeater point.

Technical program

9075 A NEW HIGH-CAPACITY MICROWAVE RELAY SYSTEM

C. G. Arnold et al., RCA Victor Co. Ltd., Montreal.

This paper will discuss the performance objectives, basic design and test results of a new high capacity microwave relay system. The system is capable of transmission of 600 frequency division multiplex voice channels with CCIR performance; it is also capable of transmitting monochrome or color video. The system uses frequency modulation and heterodyne repeaters with 70 megacycle intermediate frequency. Traveling wave tubes are used in the transmitter. A new type of antenna with superior performance is employed.

A modular expandable alarm and service channel facility has been incorporated in the basic equipment design.

Data on performance of a 2-hop field test link will be described.

9132 A MOBILE MONITORING UNIT

W. B. Smith, Department of Transport, Ottawa.

The Department of Transport has developed a mobile frequency measuring unit to function as an aid to policing the radio spectrum, a necessary arm in the work of spectrum management. The unit is a self-contained tractor trailer combination with facilities for measuring and observing the character of radio signals in the range up to 10 kmc. The unit has been developed after experiments with smaller vehicles carrying a limited quantity of measuring equipment. The new unit is large enough to carry a full complement of measuring gear and will be capable of measurements and observations to accuracies well in excess of Departmental specifications governing radio transmissions.

Friday afternoon, October 9

Session 21 **Satellite Room**

DEVELOPMENTS AT NATIONAL RESEARCH COUNCIL, OTTAWA

Chairman: **Dr. D. G. Ivey**
University of Toronto, Toronto.

McNarry

9086 DESIGN CONSIDERATIONS IN THE DEVELOPMENT OF THE OMEGATRON — A MINIATURIZED MASS SPECTROMETER

L. R. McNarry, National Research Council, Ottawa.

The application of the omegatron, which operates on the cyclotron principle, to mass spectrometry is well known. Investigation of the effects of electric and magnetic field inhomogeneities has led to improvement of the practical resolving power. Some data on the nature of the background ion current are included. Construction details of an omegatron which is useful up to mass 100 are given and a theoretical extension to any desired resolving power is discussed.

9085 A MICROWAVE POSITION FIXING SYSTEM EMPLOYING DIGITAL DISPLAY

K. Ayukawa and **R. I. Mott,** National Research Council, Ottawa.

The microwave position-fixing system is designed for line of sight position fixing over water and is expected to have its chief application in hydrographic surveying. It consists of three microwave transmitters placed at known locations ashore, and a receiver whose position may be determined by measuring the two included angles between the transmitters. This paper describes the electronic equipment used to measure and display these angles automatically. Evaluation of the inherent accuracy made from a series of laboratory tests and the results of operational trials in Georgian Bay in co-operation with the Canadian Hydrographic Service are discussed.

9037 PHASE JITTER PROBLEMS IN X-BAND FREQUENCY MEASUREMENT

H. Daams and **S. N. Kalra,** National Research Council, Ottawa.

In making high precision frequency measurements in the X-band a large order of multiplication of the reference crystal oscillator frequency is needed. This introduces a certain amount of phase jitter in the reference output frequency. Quantitative measurements of this and similar effects have been made in relation with the measurements of frequency against the National Research Council caesium-beam resonator standard. Simple techniques have been developed to measure this frequency to an accuracy of $1:10^{10}$. The phase jitter and its effects will be discussed.

Daams

Kalra

Staniforth

Craven

9092 IMPROVEMENT OF SQUARE LAW RESPONSE OF MICROWAVE RECTIFIERS

A. Staniforth and **J. H. Craven,** National Research Council, Ottawa.

Crystal rectifiers have been used for many years as video detectors in microwave measurements. In most of these applications the detection characteristic at low level is assumed to be square law. It is well known that, in general, this assumption is not justified particularly if reasonable accuracy is desired. The conditions required to increase the dynamic range over which square law response may be achieved have been investigated experimentally. It has been found that with a forward bias of 100 microamperes or more and a low video load resistance, the law of response is more closely square law with an increased dynamic range.

Session 22 **Transistor Room**

ENGINEERING MANAGEMENT

Chairman: **D. B. Watson**
Woods, Gordon and Co., Toronto.

Dawson

9124 THE NEED FOR BALANCED ATTENTION BETWEEN BUSINESS FACTORS AND TECHNICAL FACTORS IN ENGINEERING WORK

H. S. Dawson, Canadian General Electric Co. Ltd., Toronto.

Every engineering problem encountered in industry has an economic problem hidden just beneath the surface. Industry, therefore, needs all technical work to be tempered with a large amount of business perception. How can the engineer, with his consuming interest in things technical, be encouraged to apply to a greater extent, his recognized analytical powers, to the business factors interwoven in his technical problems?

The speaker describes an engineering measurement plan used in one company to target increased emphasis in this direction. Three main factors — quality, cost and time of engineering work are selected, and each engineering job is evaluated against established goals. Feed-

back of the scores achieved by the individual engineer permits self-correction to the balanced emphasis required by the business.

9011 THE COMPANY MODEL

R. Scott, Canadian Marconi Co., Montreal.

With the growing complexity of decisions facing management and the advent of new tools to aid management such as computers, electronic data processing, and operational research techniques, the need for the systems engineering of an entire company has become of interest and importance. Model concepts as applied to business organizations are presented; existing partial models are reviewed; and the limitations and requirements for the construction of a company model are developed. The company model is viewed as a major tool of the professional manager in the future.

Scott

Erlick

9072 THE FUNCTION OF PROJECT ENGINEERING IN A DEFENCE ENGINEERING ORGANIZATION

P. S. Erlick, RCA Victor Co. Ltd., Montreal.

In an engineering organization of up to 125 engineers, taking into account the present trend toward highly specialized areas in the field of electronic engineering — especially in defence products, the project engineer becomes more and more necessary.

The project engineer's duties and functions are such that he effectively coordinates the specialized engineering activities on a project, provides the proper conditions for stimulating new ideas for a better equipment, and produces savings in time and money by elimination of duplication of effort.

As electronic products become more complex, and as the state of the art changes at a rapid rate, the importance of a project engineer becomes more evident.

9126 ELECTRONIC ENGINEERING MANAGEMENT IN CANADA

J. Fogarty, Ferranti-Packard Electric Ltd., Mount Dennis, Toronto.

An analysis of the Canadian electronics market indicates that, to maintain a strong engineering position, a distinctly Canadian management approach is required. Specific experiences are outlined to highlight these management problems, with proposed solutions.

Session 23 — Aeronautics Room

COMPONENTS FOR DIGITAL COMPUTERS

Chairman: **Prof. R. W. McKay**
University of Toronto, Toronto.

9018 A NEW TRANSISTOR BISTABLE CIRCUIT

D. P. Henderson, Defence Research Board, Ottawa.

Two transistor switching amplifiers, employing a unique method for dc feedback, are interconnected in such a manner as to provide an asymmetrical bistable device, exhibiting properties similar to an electronically activated single pole double throw switch.

The device is characterized by:

1. High operating efficiency resulting from low internal impedance and negligible idling currents.
2. Very large current carrying capacity in either direction.
3. Single voltage supply operation.
4. Rapid transition speeds because of double regenerative action to either state.
5. Short resolution times due to restricted carrier storage.
6. Good triggering sensitivity.

9043 A NOVEL MAGNETIC CORE COINCIDENT CURRENT MEMORY

R. S. C. Cobbold, Defence Research Board, Ottawa.

This paper discusses the performance and construction of a novel type of coincident current magnetic core memory system. A three dimensional approach to the wiring of a coincident current memory enables the usual 45-deg. "read" wire to be replaced by a wire which is at right angles to both "drive" wires. Cancellation of the partial disturb voltages from the cores onto the "read" wire is obtained for both "drive" wires. The method of construction could enable memories to be produced in a fully automatic manner. The paper concludes with a discussion of the advantages and disadvantages of this new type of memory.

Henderson

Cobbold

9024 A DIGITAL MAGNETIC WIRE STORAGE WITH NONDESRUCTIVE READOUT

C. G. Shook, Stromberg-Carlson Co., Rochester, N.Y.

After a brief review of pertinent magnetic effects and sonic wave propagation in elastic media, a nonvolatile, digital, magnetic storage scheme is described, wherein binary words may be stored by magnetizing segments of a wire, and the information may be read out an unlimited number of times with no detrimental effects to the storage. Two storage schemes are presented, a permanent, program type store, and a temporary, electrically changeable store. Bit storage density, readout and input pulse shapes, and readout frequency are discussed. Possible limitations such as loss, temperature effects, and pulse shape are balanced against advantages and finally a comparison is made to a number of other types of bit storage.

Shook

Curry

9029 A TIME DIVISION MULTIPLEX TELEPHONE SYSTEM USING NONDESTRUCTIVE MAGNETIC STORAGE

R. C. Curry, Stromberg-Carlson Co., Rochester, N.Y.

An entirely solid-state, time-division-multiplex telephone system serving a 100-line block is described, which utilizes a non-volatile digital storage with nondestructive sonic readout. This is a temporary (that is, reversible) storage which is used to perform line finding, time-slot allotting, dial-converter allotting, and connecting. The actual connecting of lines to the highway is accomplished by solid-state controlled switches (gates).

Time-slot allotting is done on a standby basis, i.e., a time-slot is always available and as each time-slot is assigned, another is made available.

The line circuit and the dial converter utilize core-transistor logic to perform lockout, busy test, supervision and dial-pulse counting.

While certain sections of the system are continuously interrogated, the system is essentially non-synchronous and no programmer is required.

Session 24 — Pulse Room

POWER SUPPLIES

Chairman: **A. D. Revill**
Electronic Controls Ltd., Belleville, Ont.

Cox

9057 A TRANSISTORIZED HIGH VOLTAGE POWER SUPPLY FOR SCINTILLATION COUNTING

J. R. G. Cox, Sperry Gyroscope Co. of Canada Ltd., Montreal.

A high-voltage power supply covering the range from 500 volts to 4,000 volts at 10 milliamperes is described. High voltage is developed by an oscillator, transistor power amplifier, step-up transformer and high-voltage rectifier. Reference voltage is provided by a precision Zener reference diode incorporated in a transistor dc regulator circuit. Error voltage is amplified by carrier type dc

Technical program

amplifier utilizing input modulator and output demodulator and is used to control amplitude of oscillation of the oscillator. Regulation of 0.01% against both line and load changes and long-term stability of the same order is achieved.

Stedman

9080 THE DEVELOPMENT OF A PRECISION POWER SUPPLY FOR USE WITH PHOTOMETRIC STANDARDS

R. S. Richards and **B. D. Stedman,** National Research Council, Ottawa.

The paper describes the development of a voltage regulated power supply furnishing standard incandescent lamps with voltages between 10 and 120 volts at currents up to 10 amperes.

Two regulators are discussed; in each, smooth dc goes to a bank of power transistors that form a controlled impedance. The first design uses a precision Zener diode reference source, with a balanced transistor chopper amplifier and a wide band ac channel in parallel; the second employs a vacuum tube amplifier stabilized by a mechanical chopper.

Half-hour stabilities achieved were about 0.01% and 0.002% respectively.

Biringer

Slemon

9103 MAGNETIC FREQUENCY MULTIPLIERS

P. P. Biringer and **G. R. Slemon,** University of Toronto, Toronto.

This paper describes a group of power modulators in which the output frequency is some integral multiple of the supply frequency and the output power is controlled by a dc control signal. These devices consist primarily of nonlinear iron-cored coils connected in various configuration to polyphase supplies. Filtering of a particular harmonic is achieved by the system of interconnection of the coils rather than by band-pass filters. A frequency multiplier therefore provides a simple, static, and highly efficient means of producing a controllable output at higher-than-supply frequency.

The application of frequency modulators arise both from their frequency multiplication property and from their power modulation property. A number of current and proposed applications are discussed in the paper.

9099 A METHOD FOR IMPROVING THE REGULATION OF 3-PHASE POWER SUPPLIES

F. J. Heath, Canadian General Electric Co. Ltd., Toronto.

The regulation of a 3-phase full-wave rectifier when protected by current limiting reactors is much worse than would be expected if one assumes that the rectifier presents a resistive load to the power transformer. The reason for this poor regulation is that the currents drawn by the rectifiers have a very large harmonic content which is attenuated by the current limiting reactors. The use of capacitors across the secondary of the transformer provides a low impedance path for the harmonic currents and results in improved regulation of the power supplies.

In an experiment on a 50-kw broadcast transmitter the regulation was reduced from 5.2% to 2.8% by the addition of the capacitors mentioned above.

Heath

Beddoes

Session 25 **Radar Room**

COMMUNICATIONS SYSTEMS

Chairman: **S. Dmitrevsky**
University of Toronto, Toronto.

9083 CODERS FOR COMPRESSING THE BANDWIDTH OF SPEECH SIGNALS

M. P. Beddoes, University of British Columbia, Vancouver, B.C.

Excessive wastefulness of the speech waveform for representing the very limited number of speech sounds is commented on. For example, a channel with 40 db signal to noise ratio and a 3-kc bandwidth is shown to be capable of supporting not one but 300 speech signals. This is a theoretical limit. For background purposes, the following coders for compression of speech signals are described: frequency modulation; Vocoder; two frequency dividers; slope-feedback.

A new method of specifying the speech signal in terms of three parameters is given. This is shown to lead to reduced bandwidth. Possible uses of existing compressors with special attention to the, as yet untried, slope-feedback coder, with the new method are outlined.

A short description of experimental apparatus for testing the slope-feedback coder is given.

9062 AN OBSTRUCTED PATH VHF RADIO SYSTEM

J. M. Bain, The Bell Telephone Co. of Canada, Montreal.

A 120-mile, single-hop vhf radio system has been installed between Emeril, Labrador and Lake Barbel, Quebec on a temporary basis. Designed to provide teletype and telephone service to the mining community at Lake Barbel and Lake Jeannine, it consists of three parallel radio systems operating in the 152-174 mc band. The paper includes a description of the radio and multiplex equipment used plus the results of some system evaluation tests consisting of measurements of rf levels, test tone stability and circuit noise. These results are then compared with the theoretical values calculated from the original design figures.

9036 SWITCHING CONSIDERATIONS FOR STANDBY APPLICATIONS IN MICROWAVE INSTALLATIONS

M. Harp, Lenkurt Electric Inc., San Carlos, Calf., and **R. A. Marsh,** Lenkurt Electric Co. of Canada Ltd., Vancouver, B.C.

The requirements for high speed in automatic standby switching systems are reviewed. A transfer arrangement is described which is applicable to operating standby providing an anti-fade diversity feature, in addition to equipment failure protection. A second arrangement is discussed which features a microwave ferrite switch to yield milli-second service restoration. In addition, the special considerations involved in a one-standby for three-operating system are covered, with details of a practical one-for-three operating system.

Marsh

Crysdale

9016 PERFORMANCE OF THE CANADIAN JANET B SYSTEM IN THE AURORAL ZONE

J. H. Crysdale, Defence Research Board, Ottawa.

The Canadian Janet B system, developed by Ferranti Electric under DRB contract, has undergone extensive trials on a circuit in the auroral zone, between Edmonton and Yellowknife, at frequencies in the vicinity of 40 and 50 mc. Circuit performance and its correlation with geomagnetic conditions have been analysed with the assistance of an IBM 650 computer.

Performance was reasonably satisfactory during periods when the meteoric mode predominated. However, the error rate usually increased and at times became excessive when auroral propagation occurred. The circuit was adversely affected by low lying absorbing layers produced by intense solar flares.

Conclusions and recommendations are presented and discussed.

9120 DEVELOPMENT OF A SYDNEY, N.S./ST. JOHN'S, NFLD. CANADIAN NATIONAL MICROWAVE SYSTEM

C. Bridgland and **A. Piechota,** Canadian National Telegraphs, Toronto; and **B. MacKenzie,** Standard Telephones & Cables Ltd., London, England.

A 650-mile radio relay composed of 22 line-of-sight paths now supplements the Canadian National Communications

between Sydney, N.S. and St. John's, Nfld. Overcoming a 70-mile overwater section at the Sydney end of the system was a major problem. Standard Telephones & Cables' equipment suitable for transmission of television program or the equivalent of 600 toll quality message circuits was selected for the project.

The system, divided into three sections with back-to-back terminals at Corner Brook and Gander for general communications, also provides television to any locations along the route. Each section has a separate comprehensive supervisory and control facility from the terminals.

Bridgland

Piechota

A full report

of the Convention

will appear in the

November issue of CEE

- **Name**
- **Address**
- **Booth**
- **People**
- **Principals**
- **Products**

What the exhibitors are showing

† indicates IRE member; * indicates New Product

Alfax Paper & Engineering Co.,
P. O. Box 125, Westboro, Mass.
Booth 266
Milton Alden, S. C. Sviokla.
Alfax electrosensitive recording paper.

American Electrical Heater Co.,
6110 Cass Ave., Detroit 2, Mich.
Booth 558
Robert A. Kuhn, Frank W. Kuhn†, Richard C. Oxley, B. Vincent Benton.
Full line of American Beauty electric soldering irons, conventional and transformer types. Also temperature regulating stands for conventional irons, and many special sizes and shapes of tips Includes three new models of temperature regulating stands*; model T-12-XF transformer operated iron with extra-flexible, ultra-lightweight cord*; 3/32 in. tip-element for extreme precision soldering*.

The American Superior Electric Co. Ltd.,
174 Evans Ave., Toronto 18, Ont.
Booth 136
J. S. Louden, P. R. James, J. C. FitzGerald, F. W. Murphy, J. Zenuh.
Diversified line of new products under the theme "All New in '59". These include Powerstat variable transformers*, Stabiline automatic voltage regulators*, Varicell adjustable ac/dc power supplies*, Slo-Syn synchronous motors*, Flexiformer packaged transformer primary*, Dub-L-Plug dual electrical connectors*, Supercon electrical connectors*.

Ampex American Corp.,
1458 Kipling Ave. N., Rexdale, Ont.
Booth 450
J. D. Livingston, Tom Dalzell†, Hart Kinnear, James E. Detlor, Dave Ohman, Dan Hake.
Ampex audio, video and instrumentation recording equipment and accessories. Items displayed will include AR200 solid state airborne magnetic tape recorder for data acquisition*; FR100A analog tape recorder/reproducer for ground or laboratory installation; FR300 high-speed digital tape recorder/reproducer for computer applications*; TC10 fm calibration portable test instrument for calibration and alignment of any standard fm modulator/demodulator system*; SE10 automatic tape degausser for fast and complete erasing of magnetic tape; VR1000B recording head as used in Ampex Videotape recorders; computer and instrumentation tape*—the first of a full line of Ampex manufactured tapes.

Andrew Antenna Corp. Ltd.,
606 Beech St., Whitby, Ont.
Booth 258
John C. Annett†, R. P. Matthews†, R. H. Curtis†, William J. Judd.
Andrew Corp., Andrew California Corp.
Heliax flexible transmission line, extremely high power waveguide assemblies, standard rigid transmission lines, a wide assortment of communication antennas, including the well-known Unipole, high-gain omni-directional antennas, high-gain pencil beam types for microwave, and new large parabolic antennas for scatter systems*. Also plastic radomes for microwave antennas.

A. T. R. Armstrong Ltd.,
700 Weston Rd., Toronto 9, Ont.
Booth 342
A. T. R. Armstrong, D. F. Eakin, D. I. Snell, J. C. Culbert.
Sarkes Tarzian, Inc. (Rectifier Div.), Reeves Soundcraft Corp., Essex Electronics Ltd., Silicon Transistor Corp., Akro-Mils, Inc., Potter & Brumfield Canada Ltd., Good-All Electric Mfg. Co., Model Engrg. & Mfg., Inc. (Tru-Ohm Prods. Div.).
Silicon rectifiers, diodes and transistors; magnetic tape; coils, pulse transformers and delay lines, including new Essex epoxy-encapsulated modular types*; mylar, paper and polystyrene dielectric capacitors; relays; storage cabinets for tools and components; precision wire wound resistors, including new Tru-Ohm series S-AL with axial leads and silicone coating*; Reeves new vinyl electrical insulating tape*.

Astral Electric Co. Ltd.,
44 Danforth Rd., Toronto 13, Ont.
Booth 338
D. W. Rippin†, B. D. Coyne, D. Reid.
Belling & Lee Ltd., Hellerman (Canada) Ltd., Ungar Electric Tool Co. of Canada.
Belling-Lee plugs, sockets and connectors — coaxial, miniature and subminiature* types; printed circuit accessories*; fuses and holders, delay/overload switches, including new L.422 thermal delay switch*; terminal blocks and binding posts. Hellerman cable strapping, markers and tools, including high temperature markers for aircraft and similar applications*. Ungar soldering irons, elements, bits and tiplets, featuring printed circuit desoldering tips.*

Atlas Instrument Corp. Ltd.,
50 Wingold Ave., Toronto 19, Ont.
Booth 350
Les Bradford, Fred Dargeant, Bernie Feldman†, Al Rosenthal†, Tom Christiansen, Bill Terry, Barry Oliver, Al Brown, Marty Goldberg, Ed Watts.
Dymec, Electro Products Labs., Lindgren, Gertsch, Hewlett Packard, Kin-Tel, Massa, Sierra, Skydyne, Taller & Cooper, Tel-Instrument.
Hewlett Packard test equipment and Dymec test systems from dc to microwave; Gertsch frequency measuring equipment and ratio transformers; Electro Products magnetic pickup probes; Kin-Tel dc instrumentation and closed circuit television; Lindgren rf screened rooms; Sierra transmission line test equipment; Tel-Instrument voltage regulators, vibration calibrators and television test equipment; Skydyne test equipment, transit cases and mobiles; Taller & Cooper automatic data reduction and toll equipment; Massa's range of multi-channel recording systems* and rapid printers*.

Exhibits

Atlas Polar Co. Ltd.,
60 Northline Rd., Toronto 16, Ont.
Booth E24
Ralph E. Ander, Hugh MacKay, Jack Stevens.

United States Motors Corp.
Wide range of diesel, gasoline and propane powered auxiliary and standby generating sets, from 1,500 watts to 100 kw. The feature of the display will be a new 10-kw diesel "Micropower" no-break standby generating set—this unit will be in actual operation in the booth*.

Atlas Radio Corp. Ltd.,
50 Wingold Ave., Toronto 19, Ont.
Booth 344
J. R. Bass, D. McCormick, T. Keenan.

Electro Prods. Labs., H. H. Smith, Elco, Precision Apparatus, Pace Electrical Instruments, Switchcraft, Drake Mfg., E.M.I., Sargeant Electric, Borg, DeJur-Amsco.
Wide range of components and equipment including dc power supplies, radio and television hardware and components, JAN and commercial molded sockets, Varicon and other connectors, Varipak printed circuit enclosures, test equipment, panel meters, switches, microphone plugs and jacks, stack switches, pilot light assemblies and jewels, loudspeakers, tape-decks, rotary switches, precision potentiometers, fractional hp motors, Micropots and Microdials.

Automatic Electric Sales (Canada) Ltd.,
185 Bartley Dr., Toronto 16, Ont.
Booth 559
A. C. Stewart†, J. D. Breedon, R. W. Lindsey, B. H. Martin, T. Joyce, W. Carbery.

Automatic Electric (Canada) Ltd., Automatic Electric International, Inc.
A comprehensive display of Automatic Electric relays, rotary and stepping switches, push-keys, lever keys, lamp-jacks, and electrical control apparatus.
Booth 563
R. C. Fawcett, J. R. Simpson†, G. G. Bews, R. A. Marsh†, M. J. McInroy, M. Harp.

Lenkurt Electric Co. of Canada Ltd.
This display will include Mobiltel equipment, both base station and subscriber; type 23A Datatel; the new 4597 Program Channel*; type 45CX equipment, type 74A Microtel; and test equipment.

Aviation Electric Ltd.,
200 Laurentian Blvd., Montreal 9, Que.
Booth 251
F. Williams†, J. Ford, W. Ratcliffe.

Bendix Aviation Corp., M. C. Jones, Waterman Products, Aermotor Co., Aircraft Specialties, Hamlyn Electronics, Robinson Technical Products, Mark Products.
Synchros, connectors, vertical gyros, aircraft and marine communication equipment, antennas, specialized electronic and electro-mechanical equipment including the AEL ball resolver* and torpedo course control*. Complete line of Waterman Products Co. instruments and test equipment including model P1B7X2 color tv monitoring Panelscope*, model P1B2X10 general purpose Panelscope*, and model S-16-A tv and hi-fi Craftscope*.

Bach-Simpson Ltd.,
1255 Brydges St., London, Ont.
Booth 128, 229A
J. R. Bach, R. Wilton†, C. F. Bates, G. Smith, A. Peters, C. Hoskin†.

Welwyn Canada Ltd., Radiometer.
A large display of panel instruments and Canadian-made test equipment, including last year's Exhibit Award winning oscilloscope, a new concept in frequency monitor switchboard instruments*, and the new Simpson Add-a-Tester*. Welwyn high stability carbon resistors will include new types for computer applications*, and typical instruments in the electronics and electro-chemical fields will be featured in the display of Radiometer products.

Barnard Stamp & Stencil Ltd.,
8 George St., Box 295, Hamil.on, Ont.
Booth 531
R. W. S. Freeman.

Rejafix, England.
Printing equipment, inks and accessories suitable for marking capacitors, fuses, relays, resistors, transformers, transistors, tubes, etc. The line includes hand-operated, semi-automatic and fully-automatic models; printing plates and type; air drying and special ceramic inks.

Bayly Engineering Ltd.,
Hunt St., Ajax, Ont.
Booth 247, 249
Pat Bayly†, Howard Philp†, Don McPherson, Barry Joyce, Ted Doeringer, Wally Wilson.

Arnold Engineering Co., Allen B. Du Mont Laboratories, Inc., Brush Instruments, Boonton Radio Corp., Boesch Mfg. Co., Inc., Sorensen & Co., Inc., Beta Electric Corp., De Mornay-Bonardi, M.C. Jones Electronics Co., Inc.
Recording equipments and systems; transistorized power supplies, and voltage regulators; 140 kmc microwave equipments; magnetic materials, toroidal cores; single and double beam oscilloscopes; recording cameras; signal generators, rf voltage standards, Q comparator; toroidal winding equipment; filters and telephone jacks. New items include Sorensen series QC transistorized dc-to-dc converters*; Boonton type 225-A signal generator for 10 to 500 mc*; De Mornay-Bonardi W-size instruments and components for the 90 to 140 kmc frequency range*.

Beatty Brothers Ltd.,
Fergus, Ont.
Booth 162
W. H. Fuller, H. M. Anderson, R. M. Cuddy, O. B. Brown.
Models and accessories associated with the Beatty communication tower and mast line, with emphasis on the new 10 in. series diagonal-braced mast sections*.

Belden Mfg. Co.,
415 So. Kilpatrick, Chicago 44, Ill.
Booth 164
Warren Stuart, James Olson, Merton Scott (Belden); Wm. Newport, Wm. Martin, R. Stevenson (White Radio, Hamilton, Ont.).

Wide range of electronic wires and cables. Cables include microphone, sound and intercom, tv camera, broadcast audio and video, welding, coaxial, bare braided and stranded types. Hook-up wires to MIL specs., magnet and lead wires will also be displayed. New products include Beldfoil shielding, used in sound and intercom cables*; type 8283 color tv camera cable*; size 51 Celenamel magnet wire*; and type 8421 stereo or hi-fi connecting cable*.

Bishop Sons & Co. Ltd.,
588 Eastern Ave., Toronto 8, Ont.
Booth 257
G. H. Bishop, V. A. Bishop, R. W. Bishop, R. M. Bishop.
Complete facilities for the manufacture of electronic sheet metal work. Samples, models, kits, prototypes, experimental and short run production without tooling charges on chassis, cabinets, racks, panels, etc., for aircraft, communications, radar, radio and television, data processing, computers. Precision layout for hole punching, drilling, templates and jigs. Specialists in welding on all metals.

Camloc Fastener Corp.,
22 Spring Valley Rd., Paramus, N.J.
Booth 163
Bennet F. Becker, Herbert F. Peppel.
New electronic chassis latch #35L*, in addition to the proven 21L version; quarter-turn fasteners with a wide variety of head styles from the miniature 5F through the rugged 91F series; 7C1 series quick release cable and harness clamp in sizes from ¼ in. to 1¼ in. diameter; new 7F push button fastener*.

Canada Stamp & Stencil Co. Ltd.,
74 Dundas St. E., Toronto, Ont.
Booth 256
C. Thuro, K. Leonard, R. Murray.

B. Grauel & Co. K.G., The Lectroetch Co.
Wide range of industrial and commercial marking machines, supplies and equipment. Dry offset printing presses for marking component parts and finished products; electrolytic etching equipment; steel and rubber stamps, dies and printing plates; rubber printing belts; nameplates and nameplate detail presses; steel indent wheels and marking heads; stencils; inks; embossers and labelers; steel type and holders. The B3/FRV dry offset printing press with variable speed drive will be featured*.

Canada Wire & Cable Co. Ltd.,
Postal Stn. "R", Toronto 17, Ont.
Booth 452
Sales and technical personnel.

Telecables and Wires Ltd., Winnipeg, Man.
A full range of magnet wires, coaxial cables, rf cables in addition to telephone and communications wires and cables.

Canadian Applied Research Ltd.,
750 Lawrence Ave. W., Toronto 19, Ont.
Booth 349
D. J. Dalzell, P. L. Buliock, H. M. Pipher, G. J. Evans.

CARL, Rank Cintel, Robot-Foto, Librascope, Crouzet.
CARL ANADAC navigation computer system*, automatic tri-film processor, instrumentation cameras, airborne profile recorder, station magnetometer, ice detectors and de-icing controllers; Rank Cintel electronic photo printer; Robot recording cameras; Librascope computer components; Crouzet true airspeed computer.

The Canadian Astronautical Society,
Downsview, Ont.
Booth 566, 570, 572
Members of CAS.

A substantial astronautical display — in addition to items of Canadian origin, most of which will be submitted by the Society itself, there will be several impressive items, never before shown in Canada, made available by the United States Army Signal Corps, who are guests of the Society at the convention. See special report on page 69.

Canadian Electronics Engineering,
481 University Ave., Toronto 2, Ont.
(Maclean-Hunter Publishing Co. Ltd.)
Booth 360
C. A. King, Harold Price†, I. R. Dutton†, R. E. Swan, K. Winchcombe.

The technical publication serving Canada's electronics industry in management, research, design and application. Published monthly on the 4th. Industry Review and Forecast in January; New Products Review in March; Components and Equipment Directory in June; Pre-IRE Canadian Convention issue in October.

Canadian General Electric Co. Ltd.,
Electronic Tube Section (Radio Valve Co. Ltd.),
189 Dufferin St., Toronto 3, Ont.
Booth 352
John R. Oakley, R. S. Thompson†, W. Shenton, R. E. Magnus, G. R. Farrell.
Semiconductor devices including rectifiers, controlled rectifiers*, transistors and diodes. The display will include an operating demonstration of the silicon controlled rectifier, and a setup for the sortation of semiconductor diodes.

Canadian Marconi Co.,
2442 Trenton Ave., Montreal, Que.
Booth 137, 139, 141
A. Marshall, W. Halton, John Robinson and others.

A full range of radio relay systems and of land, sea and air communications and navigational equipment, closed circuit television, instruments, and special installation and maintenance services.

Canadian Marconi Co.,
Electronic Tube & Component Div.,
830 Bayview Ave., Toronto 17, Ont.
Booth 145
J. Biscott, H. Tracey, R. Cameron, G. Morton†, A. Ferry†.

National Radio, Clarostat.
Complete line of electron tubes, National receivers, Clarostat resistors and controls. The new 23-in. Marconi RVC television picture tube will be featured*.

Canadian Patents and Development Ltd.,
National Research Building, Ottawa, Ont.
Booth 345
J. R. Johnson, K. G. Lund, S. A. Gardiner.

National Research Council, Department of National Defence, and other Government Departments.

All items on display will be new inventions owned by the Government of Canada, and available to industry under license. See special report on page 71.

Canadian Pratt & Whitney Aircraft Co. Ltd.,
P. O. Box 10, Longueuil, Que.
Booth 545
J. E. Smith (Cdn. Pratt & Whitney), and representatives from each department of Norden.

Norden Div. of United Aircraft Corp.
Synchros, servo motors, numerical control equipment, analog-to-digital encoders, fire control equipment, closed circuit television camera.

Canadian Radio Technical Planning Board,
200 St. Clair Ave. W., Toronto 7, Ont.
Booth 131
Unmanned rest booth.

Canadian Research Institute,
46 St. George St., Toronto 5, Ont.
Booth E10
R. Spencer Soanes, Egon Manthey, Wolfgang Petschke.

Canadian Research Institute, P. Gossen & Co., GmbH, Baird-Atomic, Inc., Photovolt Corp., Buckleys (Uvral) Ltd., Emel Establishment.
Electronic test equipment, panel meters, precision portable electrical instruments, geophysical instruments, industrial test sets, high voltage breakdown testers. New products include Emel magnesium-alloy housed 8mm professional movie camera*; Baird-Atomic model KY-1 direct reading flame photometer*; CRI model DV-12V dc high-voltage test set and wire sparker*.

Canadian Westinghouse Co. Ltd.,
Tube Div., Box 510, Hamilton, Ont.
Booth 252
A. Peters, G. F. Beaumont†, J. W. Anderson†, E. D. Smith, W. Choat.

Range of receiving, cathode ray, power and industrial tubes. A feature will be a special operating display of the Permadion memory tube*.

Central Scientific Co. of Canada Ltd.,
146 Kendal Ave., Toronto, Ont.
Booth 166
W. G. Eidt, J. B. West, E. G. Beattie.

Atomic Laboratories, Inc.
Complete line of vacuum pumps and accessories for tube manufacturers or wherever high vacuum is required in the electronics industry, including drying ovens, and Flo-Atron multiple flow discharge units.

CERL-DALE Ltd.,
18 Curity Ave., Toronto 16, Ont.
Booth 260
K. J. S. Beeby, J. Brandfas, K. Game, I. Gates, G. Pointon.

Dalohm precision wire wound, deposited carbon and metal film resistors; miniature power resistors; trimmer potentiometers*; power type wire wound vitreous enamel coated fixed resistors and rheostats; variable transformers; automatic and manual voltage regulators; custom-designed and made resistors.

C. P. Clare Canada Ltd.,
2700 Jane St., Box 134, Downsview, Ont.
Booth 246
Victor H. Ames, Allan H. Royce.

A complete range of relays, including hermetically sealed, subminiature, mercury-wetted contact, and telephone types, together with stepping switches. An additional feature will be a recently developed filament voltage regulator, designed primarily for vehicular communication applications*.

Collins Radio Co. of Canada Ltd.,
11 Bermondsey Rd., Toronto 16, Ont.
Booth 551
A. I. O. Davies, J. H. McLeod, H. Binions, E. H. Edge†, P. R. Wharton, M. Fothergill.

Collins Radio Co., Cedar Rapids, Iowa.
Airborne equipment including AN/ARN-46 Tacan navigation set, AN/ARC-552 uhf transceiver, 618T ssb hf transceiver, 621A-2 transponder, doppler navigation system, 17L-8/51X-3/344D-1 lightweight vhf communications set, and the new 618F-1 360-channel lightweight vhf transceiver*. Scale model of log periodic antenna for ground communications*. Automatic tape control*, record and playback amplifiers for broadcast. A complete amateur station of the new S-line ssb/cw equipment, including 75S-1 receiver*, 32S-1 exciter/transmitter*, and 30S-1 amplifier*.

Accent on astronautics

Space electronics will be featured at the Convention in both a complete session of papers on Friday morning and a comprehensive display by The Canadian Astronautical Society in Booths 566, 570 and 572.

CAS expects to present the following items: a working exhibit of the CHARM (Canadian High Altitude Research Missile) electronic system, including the telemetering transmitter, encoder, receiver, decoder, automatic data-reduction unit and recorder; rocket-motor thrust rig, and solid propellant loading and extraction machine; full-scale CHARM rockets; dummy solid-propellant fuel grains in inhibitors, a tracking receiver, firing panel and full-scale rocket launcher.

Other items, made available by the United States Army Signal Corps, include: full-scale "Cloud Cover Satellite" of the type recently put into orbit; full-scale Vanguard satellite employing solar batteries to power its electronic circuitry; the electronic system of the "Score" Atlas satellite of the type used to transmit President Eisenhower's message from space; and an exhibit demonstrating an advanced dc converter for space research instrumentation.

Other space electronics items used in the U. S. Army's astronautical research program will also be displayed.

Photo shows CAS helical antenna used for tracking the Pioneer II moonprobe, mounted outside the Automotive Building at last year's Convention.

Conrad, Inc.,
141 Jefferson St., Holland, Mich.
Booth 244
Donald F. Beechey, Charles F. Conrad, Roger D. Kragt, Keith L. Dadd.

New Temp-Rac 19 portable chamber for high and low temperature conditioning or testing*.

The Constanta Co. of Canada Ltd.,
280 Regina Ave., Montreal 19, Que.
Booth 146
R. P. Aldred, Bruce M. Pfeiffer.

High stability precision carbon film resistors, including molded and hermetically sealed types from 1/10 watt to 2 watts. The range will be illustrated by three sizes of molded resistors: type N-5-M, ½ watt, 10 ohms to 5 meg, ±1%; N-8-M, ¼ watt, 10 ohms to 2.5 meg, ±1%; N-9-M, ⅛ watt, 10 ohms to 1 meg, ±1%.

Constellation Components Co.,
136 Tower Dr., Scarborough, Ont.
Booth 449
C. G. (Chuck) Bell, E. J. (Jack) Mulvey.

Licon, Engel & Gibbs, Muirhead, Torsion Balance Co., Electro Development Corp., Autotronics, Moog Valve.
Switches, servo components, transformers for transistorized and airborne equipment. New products will include sensitive mercury switches*.

Allan Crawford Associates,
P. O. Box 214, Willowdale, Ont.
Booth 358
Allan R. Crawford, R. M. Ghen, N. Sloan, J. H. Smiley.

Electronic Associates Inc., John Fluke Mfg., Technical Measurement Corp., Weinschel Engrg.
PACE TR10 transistorized analog computer*, X-Y plotters, digital voltmeters; Fluke ac-dc differential digital voltmeter*, .005% accurate current supply* and voltage source*, 1,500 and 2,000-volt high stability nuclear supplies*, and other types of instrumentation including dc differential voltmeters, calibration and laboratory power supplies; Tech. Meas. totally transistorized 256-channel pulse height analyzer*, complete range of radiation measuring equipment including scalers, single-channel pulse height analyzers and ratemeters; Weinschel precision attenuators, terminations and new dual-channel insertion loss measuring equipment*, attenuator calibrators and a thermistor bridge*.

Geo. W. Crothers Ltd.,
1101 Millwood Rd., Leaside, Toronto 17, Ont.
Booth 133
D. K. Richardson, A. R. Oliver, P. C. Nielsen.

Kohler Co.
Generating plants of various sizes, stressing standby and mobile application for electronics, in ratings from 500 watts to 500 kw. Gasoline, propane or diesel engine driven, air or liquid cooled, standby or sole source. A complete supply of components, including switchgear, is also available. New electric plants available include 2, 5 and 7.5-kw air-cooled diesel generating plants in manual, remote or push-button start, and in various ac voltages*.

Daystrom Ltd.,
840 Caledonia Rd., Toronto 19, Ont.
Booth E26
H. W. Cowan, D. Beattie†, G. Rosamond, R. J. Berry, W. Clark, C. Rutledge, R. Rae, G. Kennedy.

Daystrom-Weston, Daystrom Pacific, Daystrom Transicoil, Heath Co.
Calibration consoles, panel meters*, precision metal film vamistors*, micro-module wafer resistors*, zero load electronic milli-voltmeter-ammeter*, sensitive relays, portable and laboratory standard instruments, precision wire wound potentiometers, including rectilinear trimmer, high temperature miniature trimmer and subminiature trimmer and subminiature ten-turn potentiometer. Various sizes of motors and motor-generators for both 60 and 400 cps, and synchronous motors. Mutual conductance tube analyzers, educational computers, read-out oscilloscope, transistor checker, transistorized portable clock radio, various Heath hi-fi systems.

Exhibits

Department of Transport,
Telecommunications Branch,
Ottawa, Ont.
Booth546
DOT personnel.
See special report on page 73.

Douglas Randall (Canada) Ltd.,
126 Manville Rd., Scarborough, Ont.
Booth 253
Geoff Geduld, H. D. Randall, E. Muldoon, L. Williams, R. Smith.
Bourns Labs., Inc., ETC, Inc., North American Electronics, Diehl Mfg Co., Electronic Controls Ltd., Taurus Corp.
Trimpot potentiometers, coils and transformers, silicon rectifiers, solderless terminals, servomotors, resistors, and other components and equipment.

Dynamic Gear Co., Inc.,
20 Merrick Rd., Amityville, L.I., N.Y.
Booth 336
Tom Smith, Tony March, E. E. Whittaker, Jim Scammel.
Precision stock gears, hollow shaft and solid shaft differentials, assemblies, slip clutches and engineering services. A precision miniature three-gear differential will be featured*.

E.M.I.-Cossor Electronics Ltd.,
Woodside, Halifax County, N.S.
Booth 142
Harry Clarke, F. J. Martin†, E. C. Richards, G. Beyrouty, C. Garrison.
E.M.I. Electronics, A. C. Cossor, Dawe Instruments, Rank-Cintel, Spencer-Kennedy Labs.
Wide range of oscilloscopes and ancillary equipment, stroboscopes, dynamic balancing equipment, noise and vibration measuring and analyzing equipment, closed circuit television equipment, special amplifiers, preamplifiers, oscillators, generators, ultrasonic cleaning equipment, etc. The new "Emitape" magnetic recording tape and the L2B portable tape recorder, specifically designed for the professional user, will be on display*. Other items of particular interest include E.M.I. closed circuit television cameras, Cossor logarithmic amplifier, E.M.I. type 6 stroboscope, E.M.I. W.M.16 wide band oscilloscope, and various working demonstrations.

Edwards High Vacuum (Canada) Ltd.,
Cumberland Ave., Box 515,
Burlington, Ont.
Booth W22
R. G. Webster, P. W. King, M. P. Michaels, G. E. Neapole, M. Inglis.
Edwards High Vacuum Ltd., England; S.A.E.S. Getter Co., Italy.
A new 12-in. laboratory or small production coating unit will be operating and thin films will be deposited at the show*; new low cost leak detector*; ultra-high vacuum components to measure and obtain pressures to 10^{-11} mm of mercury; diffusion pumps with ultimates to 5×10^{-7} mm of mercury; vacuum gauges and accessories.

Eitel-McCullough, Inc.,
798 San Mateo Ave., San Bruno, Calif.
Booth 129
R. D. B. Sheppard, Berkley J. Baker, Fred Speaks, Fred Johnstone, Hal Yokela, Robbie Robinson, Warren Hoffman.
Eimac electron power tubes, super-power klystrons, negative grid and ceramic reflex klystrons, ceramic traveling wave and transmitting tubes. Display will include a working 1,000 watt klystron which delegates will be able to tune and adjust for themselves.

Electro Sonic Supply Co. Ltd.,
543 Yonge St., Toronto 5, Ont.
Booth 159
C. D. MacKenzie, H. Nogly, A. Herron, B. Barnet, Miss B. Dempster, J. Moore, C. Savage.
Pacific Semiconductor, Philco, Vitramon, Elmenco, Cambridge Thermionic, General Transistor, Pennsylvania Fluorocarbon, W. H. Brady.
A wide selection of electronic components and equipment, together with full technical information, representative of the stock normally available from Electro Sonic.

Electrodesign,
35 Mulholland St., Toronto 19, Ont.
Booth 366
H. H. Schwartzt, H. C. Schwartz.
Franklin, Nagard and other principals.
Components, equipment and instruments including the Nagard dual channel oscilloscope and pulse generator, and the Franklin digital voltmeter.

Electrochemical Products,
Agincourt, Ont.
Booth 562
A. G. Shackt, John Babyt, John De Groott, R. White and principals' representatives.
B & F Instruments, Behlman, Burr Brown, Computer Measurements, Electro Instruments, Electro Mechanical Research, Electron Prods., Electronic Tube Corp., Film Capacitors, General Communications, Holt, Kistler, Lab. for Electronics, Levinthal, G. T. Meillon, Metronix, Miniature Electronic Corp., Nems Clarke, Northeast Scientific, Perkin Engrg., Photron, Radiation Counter Labs., Arthur C Ruge, Sage Electronics, Schaevitz Engrg., J. Langham Thompson.
Oscilloscopes and cameras, transistorized power supplies, high voltage power supplies, ac power supplies, audio voltage standards, bridge balancing and calibrating units, accelerometers, timers and counters, panel mounted electronic voltmeters, transistorized amplifiers and millivoltmeters, transistorized digital meters, oscillographic and direct-writing recorders, radar test sets and beacons, special purpose fm, am and cw receivers, transmitters, modulators, scintillation crystals, engine indicator systems, measuring, indicating, recording and controlling devices, nucleonic instruments, world's smallest potentiometers, resistance thermometry elements, miniature wire wound power resistors, plastic film dielectric capacitors, transducers and test instruments.

Electronic Industries Association of Canada,
200 St. Clair Ave. W., Toronto 7, Ont.
Booth 362
Unmanned rest booth.

Electronics and Communications,
450 Alliance Ave., Toronto 9, Ont.
(Age Publications Ltd.)
Booth 435
T. W. Lazenbyt, R. C. Poulterț, H. E. (Bud) Dallynț, J. R. Stocks, Miss D. K. Trowell.
Electronics and Communications magazine — Canada's pioneer journal in the field of electronics and communications engineering.

Ferranti-Packard Electric Ltd.,
Industry St., Mount Dennis, Toronto 15.
Booth 337
G. W. L. Davist, L. R. Wood, F. M. Squires, D. Nuttall, J. Buck.
High speed paper tape readers; magnetic storage drums; digital reservation equipment; rectifier stacks, photocells, pnpn switching diodes*.

General Radio Co.,
99 Floral Parkway, Toronto 15, Ont.
Booth 152
Arthur Kingsnortht, Stephen W. DeBloist, Robert E. Wilson, Richard J. Provant, C. E. Worthent.
General Radio Co., West Concord, Mass.
Instruments, accessories and standards for laboratory, industry and military applications. Includes type 1429-A fuel gauge tester*; type 1650-A universal impedance bridge*; type 1305-A low frequency polyphase oscillator*; type 1521-A graphic-level recorder; type 1554-A sound and vibration analyzer*; type 1632-A inductance bridge*. Also standards of resistance, inductance and capacitance; Variac auto-transformers; and a basic set-up for coaxial cable measurements.

The Glendon Instrument Co. Ltd.,
44 Wellington St. E., Toronto, Ont.
Booth 335
S. A. Rybb, D. A. Pitman, Miss Olivia Padgett.
Wayne-Kerr Laboratories Ltd., Electronic Instruments Ltd., Evans Electroselenium Ltd., Croydon Precision Instrument Co.
High accuracy and stability ph meters; automatic titrimeter; vibron electrometers; portable electrometer used as dosimeter*; non-contacting vibration meter* and micrometer*; bridges covering frequency range from 1000 cps to 250 mc; transistor adaptor for use with 15 kc to mc bridge*; electronic thermometer; photo-electric instruments for chemical and medical applications; dc potentiometers; kelvin and wheatstone bridges; fluorometer.

Hammond Mfg. Co. Ltd.,
Edinburgh Rd. & Speedvale Ave.,
Guelph, Ont.
Booth 454
Ross E. Wilson, Bob Brucet, Bob Brownț, Crawford (Robbie) Robinsonț, Peter Duncan, Harley Eiler, Ernie Britton, K. W. Hammond, L. M. Hammond, R. S. Hammond, F. O. Hammond.
Representative examples of iron-core and ferrite-core components, including transformers, chokes and reactors both for commercial application and to MIL-T-27 and JCNAAF-T-19 specifications. Also on display will be high quality custom and stock metal items and cabinets for the electronics industry.

Heinemann Electric Co.,
Pennsylvania Ave. & Plum St.,
Trenton, N.J.
Booth 343
B. A. Berlin, Edgard Bromberg, R. S. Kurtz, Bernard A. Plesser, Douglas T. Shaw.
Electronic components, including circuit breakers, overload relays, and time delay relays.

John Herring & Co. Ltd.,
3468 Dundas St. W., Toronto, Ont.
Booth 265
John Herringț, Fred Utter, Tom Stone, Milton Prince, Jack McNiff.
AEMCO, Barber-Colman, Fortiphone, H. B. Instrument Co., Hardwick-Hindle, Landis & Gyr, Mucon, George Rattray, Shallcross, Stevens-Arnold, Industrial Tectronics, Superite, Ripley.
Relays, timers, flashers, fractional hp motors (shaded pole, synchronous, reversible, geared head), subminiature transformers, meteorological thermometers, resistors and rheostats, miniature ball and roller bearings, subminiature and voltage sensitive ceramic capacitors, precision potentiometers, precision wire wound resistors, resistance standards, resistance boxes, percent limit bridges, wheatstone bridges, fault location bridges, galvanometers, rotary selector switches, special precision ball bearings, miniature differentials, electronic controls.

Honeywell Controls Ltd.,
Vanderhoof Ave., Toronto 17, Ont.
Booth 351
W. J. Rimmer, J. C. Cowdrey
MICRO SWITCH, Marion Instrument, and Semiconductor Products Division.
A complete line of MICRO SWITCH products, featuring the new Series II lighted pushbuttons*, and the One-Shot pulse switch*; display showing the 16 different colored cases available on the Marion Medalist line of panel meters*, and the Marion MCE-1 edgewise meter*; voltage regulator display utilizing the new Honeywell 3N45 power tetrode*.

M. J. Howard & Co. Ltd.,
1206 Bank St., Ottawa.
Booth E12
M. J. Howardț, C. L. Emerson Jr.ț, G. Eganț, W. W. Bartellț.
Emerson & Cuming, Waters Mfg., IMC Magnetics.
Plastic dielectric materials, precision potentiometers, blowers, motors and servo components.

Hysol (Canada) Ltd.,
P. O. Box 53, Stn. "R", Toronto 17, Ont.
Booth W4
Russell H. Smith, David Caven, Bill Jennert, Walter Thorpe.
Epoxy insulating materials for potting and encapsulation of electrical and electronic power components. A new line of epoxy dipping compounds will be featured*.

The Institute of Radio Engineers, Inc.,
72 West 45th St., New York 36, N.Y.
Booth 164
William C. Coppț, Herbert A. Whitet.
Publications of IRE, including proceedings, directory, standards, and transactions of pro-

fessional groups; IRE emblems, pins and membership information.

Instronics Limited,
11Spruce St., Box 100, Stittsville, Ont.
Booth 553
John Knowles, R. W. Price, D. E. Leach, D. Kromka, R. Fara.
Allegany Instrument, Datex Corp., Donner Scientific, Empire Devices, Lavoire Labs., Millivac Instruments, Potter Inst. Co., Racal Engrg., Radio Frequency Labs., Schomandl K.G., Stelma Inc., Texas Instruments.
Equipment and instrumentation for the computing, data handling, communications, industrial and laboratory fields. New products include Lumatron model 12 oscilloscope*; Racal model RA.17C/RA.66 panoramic receiver*; Donner model 3500 analog computer*; Datex model K-120 recorder print-out*; Lavoie model LA-302 Robotester*, LA-70A frequency meter* and LA-20W spectrum analyzer*; RFL model 1605 comparator*; TI servo recorder*.

International Rectifier of Canada Ltd.,
1581 Bank St., Ottawa, Ont.
Booth 461
E. F. Johnson†, J. Cataldo†, J. Vickrey†, J. Conto†.
Silicon, germanium and selenium diodes and rectifiers; germanium self-generating and silicon photocells; silicon controlled rectifiers*.

International Systcoms Ltd.,
8235 Mountain Sights Ave.,
Montreal, Que.
Booth 255
J. J. Kingan†, W. Ornstein†, J. Kingsnorth, J. DiMichele.
Hasler A. G.
Land mobile and fixed fm, vhf radio telephone equipment, including new 30-watt units*; type PAX-12 12-line automatic telephone switchboard*; resonance and polarized relays*; automatic dial telephones; Impulsograph, for recording the operating characteristics and performance of relays*.

Jerrold Electronics (Canada) Ltd.,
50 Wingold Ave., Toronto 19, Ont.
Booth 443
Ken Hynes†, Alex Kirkaldy†, Alex Dworkin†.
Wide band sweep generators, with range from 500 kc to 1200 mc; variable attenuators; oscilloscope pre-amplifiers; coaxial switches; crystal marker generators.

Kay Electric Co.,
14 Maple Ave., Pine Brook, N.J.
Booth 536A
John Gilmore, Kenny Scherzer.
Sweeping oscillators, including Vari-Sweep model 400, noise figure measuring equipment, spectrum analyzer for telemetry at audio frequencies, transistorized test equipment, measurement of gain and loss in microwave systems, post carrier generators.

Keithley Instruments, Inc.,
12415 Euclid Ave., Cleveland 6, Ohio.
Booth 556
Robert D. Wood.
Electrometers, micro-microammeters, dc vtvm's, micro-volt/ammeter, milliohmeters, megohmeters, ac decade isolation amplifier, differential dc amplifier, static meter, regulated high voltage supply.

Kester Solder Co. of Canada Ltd.,
51 Bruce St., P. O. Box 474,
Brantford, Ont.
Booth 543
Ernie Walton, Paul Perrault, C. L. Barber, Jon Lloyd-Jones, J. A. T. Butler.
Kester's full line of cored solders, external fluxes, solid wire and bar, and Solderforms in many shapes and sizes will be on display. Technical personnel will be on hand to discuss problems and the use of these products in particular applications.

Lake Engineering Co. Ltd.,
123 Manville Rd., Scarborough, Ont.
Booth 436, 438
A. Ainlay†, R. J. A. Turner†, F. P. Taylor, E. E. Thompson.
Aladdin Electronics, Bircher Corp., Chicago Miniature Lamp, Consolidated Electronic Equipment, Continental Carbon Corning Glass, Dialight Corp., Erie Resistor, Garlock Packing, Grayhill, Grigsby, Hawkesbury Wire, ITT Components Div., Kearfott (ferrites), James Knights Co., Kuthe Labs., Leecraft, Litton Components Div., Microdot, C. R. Sneigrove, Stanwyck Coil, Stegg Electric, Transistor Electronics, Plastic Capacitors.
A broad selection of the latest in electronic components, each illustrating the state of progress achieved in each field. The exhibit will be modular in form, enabling it to be used for in-plant shows during the coming year.

Masson Seeley & Co., Ltd.,
Booth E18, E20.
F. T. Powell, R. G. Cocks, J. C. Bain.
Industrial marking equipment, together with a wide variety of marked samples which will illustrate the versatility of the equipment. Machines include the Masseeley models 31, 33 and 41A. and many leading Canadian electrical and electronic manufacturers have kindly lent their marked products for display.

The McBee Co. Ltd.,
179 Bartley Dr., Toronto 16, Ont.
Booth 329
P. R. Warkenton, S. J. Crause, W. G. Glover, Miss M. Naysmith.
LGP-30 general purpose electronic digital computer, and the new High Speed Reader*, for reading information from punched paper tape into the LGP-30 computer.

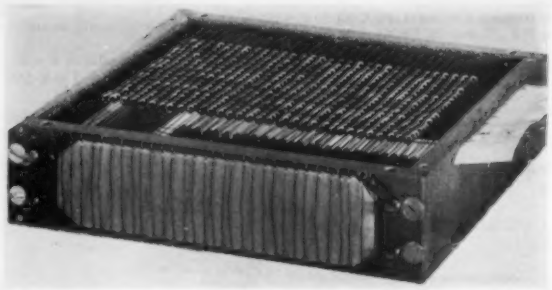
McCurdy Radio Industries Ltd.,
22 Front St. W., Toronto, Ont.
Booth 245
George E. McCurdy†, Ken MacKenzie†, Pat Warhurst, Norm Farr.
McIntosh Laboratory, Inc.
Audio equipment for the broadcast, television and motion picture industries, including the new SS5000 packaged master control console. High fidelity equipment under the trade-name "McIntosh," and phonograph turntables.

Measurements, A McGraw-Edison Div.,
Box 180, Boonton, N.J.
Booth 555
Al Eldridge, H. Roy Gray.
Laboratory type signal generators, transistor test sets, grid dip meters, fm signal generators, pulse and square wave generators, vacuum tube voltmeters. The model 560-FM signal generator will be featured, because of the great interest in test equipment designed for mobile radio equipment.

Mel Sales Ltd.,
1969 Avenue Rd., Toronto, Ont.
Booth 534
F. J. Ball, J. B. Turner†, Lyle Smith, A. McQuarrie.
Boonton Electronics, Endevco, Frequency Standards, Int'l. Radiant, Instrument Development Lab., Kay Electric, Krohn-Hite, Ling Electronics, Narda, Reflectone, Sanders, Sensitive Research Instruments, Servo Corp. of America, Technology Instrument Corp., Trad Electronics, Weldmatic.
A display of the latest in electronic test instruments and components, including the newest development in harness wiring using printed flexible techniques*. The new Trad model SG-54 signal generator will also be featured*.

T. M. Moran & Associates,
74 Pleasant Blvd., Toronto, Ont.
Booth 467
T. M. Moran†, R. Van Middleswork, M. Eustace.
Services: management consultation, manpower research, professional and executive placement.

Canadian inventions on display



Canadian Patents and Development Ltd., a subsidiary of National Research Council, is a crown corporation responsible for licensing government-owned inventions to industry.

On display in Booth 345 will be models of inventions now available on royalty or other basis. They come from the Department of National Defence and other government departments, National Research Council, and Atomic Energy of Canada Ltd. They include:

An inexpensive, accurate sine/cosine potentiometer; a slow decay device for electronic music; a cooling device for power transistors; a new type of magnetic core memory for a digital computer and a jig for making it; the circuitry of a Doppler radar; a uhf coaxial line amplifier; a small lightweight power unit for battery operated equipment; an automatic frequency control system for the reception of frequency shift keyed signals; a digital function resolver; and a transistor current overload protective circuit.

The magnetic core memory will be the subject of paper 9043 to be presented by R.S.C. Cobbold of the Defence Research Board on Friday afternoon. He will describe how a three-dimensional approach to the wiring of a coincident current memory enables the usual 45-deg. "read" wire to be replaced by a wire that is at right angles to both "drive" wires. The method of construction is such that memories could be produced in a fully automatic manner by the use of appropriate jigs.

Exhibits

Morina Electronics Engineering Co.,
52 Advance Rd., Toronto 18, Ont.
Booth 444
L. G. Morina, F. Morina, H. Meath, Mrs. J. Hawes.
Television antennas and towers, including the Skychief and Wavemaster antennas*, Skyline and Royal towers*.

National Research Council,
Ottawa, Ont.
Booth 345
See under Canadian Patents and Development Ltd.

National Semiconductors Ltd.,
146 Bates Rd., Montreal 26, Que.
Booth 134
D. A. Anderson†, George Pankau, George W. Redmond†.
Standard and special Cadmium Sulphide and Cadmium Selenide photoconductive cells. Standard cells to be exhibited include the NSL-2P, -3P and -4P open types*; NSL-5, -6 and -7 head-on types*; NSL-11, -12 and -13 sealed tubular types*. Typical applications will also be demonstrated.

New Departure Div., General Motors Corp.,
Bristol, Conn.
Booth 254
L. S. Merrill, Jay Clark II, John MacKinnon, George Sharp, Thomas Benham, Ernest Pilsworth.
R & M Bearings Canada Ltd.
A comprehensive display of the various ball bearings used in instruments and guidance systems.

Northern Electric Co. Ltd.,
1600 Dorchester St. W., Montreal, Que. and Belleville, Ont.
Booth E14
M. Beresford, A. H. Gregory†, H. Loiselle.
General Precision Labs.
Wire and cable products, including coaxial cable; R5470B master control system for radio broadcast station studio operation*; industrial television equipment; traffic monitoring equipment (in operation); industrial type Senior Magnaphone intercommunication equipment*.

PIC Design Corp.,
477 Atlantic Ave., East Rockaway, L.I., N.Y.
Booth 235
John L. Swane, Philip French.
Precision breadboard kits for research and development, and a complete line of electromechanical stock parts of precision quality — gears, bearings, differentials, couplings, spacers, shafts, bevel gear boxes, etc. New products include a series of master precision breadboard kits*, and ultra precision ground shafting*.

Philips Electronics Industries Ltd.,
Electronic Equipment Group,
116 Vanderhoof Ave., Toronto 17, Ont.
Booth 549
Harvey L. Pollock†, George W. Crossan†.
Philips, A. W. Haydon, Ebert Electronics, Haydon Switch, Scientific Atlanta, Oil Well & Water Locating Co., Analogue Controls.
Broadband communications equipment, ionospheric sounder, noise analyzer, recorders, relays, switches, potentiometers.

Polarad Electronics Corp.,
43-20 34th St., Long Island City 1, N.Y.
Booth 530
A. A. Goldberg, R. J. Sheloff.
Complete line of microwave test equipment including spectrum analyzers, signal generators and receivers.

Potter & Brumfield Canada Ltd.,
135 Oxford St., Guelph, Ont.
Booth 361
Alan Laws, T. B. White.
Wide range of electro-magnetic relays of the following types: telephone, sensitive, general purpose, miniature, subminiature, latching and special purpose. New items include the series KA small general purpose CSA-approved relay*, and micro-miniature relays with terminals located on .2 in. x .2 in. co-ordinates for automatic printed circuit assembly techniques*.

Premier Metal Products Co.,
337 Manida St., New York 59, N.Y.
Booth 330
Edwin L. Kossoy, Walter Odze.
Consoles, racks, cabinets, chassis, utility boxes, speaker boxes, panels, cases, etc. New items include Prem-O-Rak modular consoles*, and heavy-duty Prem-O-Rak transmitter racks*.

Prentice-Hall, Inc.,
Englewood Cliffs, N.J.
Booth 463
Wally Matheson.
Publishers of books in the field of electronics, engineering and science. Now displaying an advance copy of "Encyclopedic Dictionary of Electronics and Nuclear Engineering" by Sarbacher, to be published in November, 1959*.

RCAF Institute of Aviation Medicine,
1107 Avenue Rd., Toronto, Ont.
Booth 542
Flt.-Lt. J. M. Wheelhouse, F/O W. D. Macnamara.
Copper "man" used for clothing insulation assessment*; new protective helmet for aircrew with liquid seal ear "buns"*; quick-adjust oxygen mask suspension*.

R-O-R Associates Ltd.,
1470 Don Mills Rd., Don Mills, Ont.
Booth 261, 263
J. S. Root, R. Haywood, R. Wood, W. Hastings, J. Stemler.
Beckman Instruments, Inc. (Berkeley Div.), Bomac Labs., Inc., A/S Bruel & Kjaer, Helipot Div. of Beckman Instruments, Inc., Hughes Aircraft Co., International Electronic Research Corp., F. L. Moseley Co., Precision Instrument Co., Sanborn Co., Wandel & Goltermann.
Comprehensive display of new components and instruments, including Moseley strip-chart recorder, x-y recorder with character printer, tape translator; Sanborn 8-channel recording system and x-y recorder; Hughes semiconductor products; IERC tube shields; Helipot precision potentiometers, featuring Canadian-made items; Bomac micro-wave tubes and components; Bruel & Kjaer test instruments, featuring an electronic voltmeter; Precision instrumentation tape recorder; Berkeley eput meters and counters*.

Radio Trade Supply Ltd.
595 Yonge St., Toronto, Ont.
Booth 236
Frank White Jr., Eugene Hyshka, Al Chrysler, Ward Leonard, Sprague, Rogers, Knight Kit.
Ward Leonard wirewound resistors and relays; Sprague capacitors; Rogers special purpose, transmitting and industrial tubes; Knight Kit test equipment and hi-fi amplifiers, etc.

Radionics Ltd.
8230 Mayrand St., Montreal 9, Que.
Booth 451
S. H. Ungar, R. H. Carleton, G. Sadoer, D. Kirshner, G. F. McCarthy.
Airborne Instruments Lab., FXR Inc., Veeco Vacuum Corp., Huggins Labs., N.J.E. Corp., Julie Research Lab., Westronics Inc., Southwestern Industrial Electronics Co.
Comprehensive display including microwave components and instruments, automatic noise-figure indicator equipment, nuclear instruments, standards of resistance and voltage, recorders, high vacuum and leak detection equipment, traveling wave tubes, and general purpose test instruments. New products will include a complete range of 2 mm components from FXR Inc.*; SIE model R-2 voltmeter*, K-1 Microsource*, and N-1 signal generator*.

Raytheon Canada Ltd.,
61 Laurel St. E., Waterloo, Ont.
Booth 367
J. R. Cann, J. E. Kadish†, R. S. Williams, B. S. McConachie, T. W. R. East, T. deHaas, R. W. Dankwardt, H. O. Dykes, M. M. Feilchenfeld, L. R. Flumerfelt, J. M. Haynes.

Raytheon Co., Waltham, Mass.
Components, transistors and vacuum tubes, including microwave power tubes. Also a radar-to-television scan converter for Bright Display systems*.

Renfrew Electric Co. Ltd.,
349 Carlaw Ave., Toronto 8, Ont.
Booth 231
Sales and engineering staff.
Divisions of Renfrew Electric: IRC Resistors, Jensen Speakers, Struthers-Dunn Relays. Also Amphenol Canada Ltd., Airtron Canada Ltd.
Resistors, connectors, speakers, transformers, coaxial cable, relays, microwave components.

Rogers Electronic Tubes & Components,
116 Vanderhoof Ave., Toronto 17, Ont.
Booth 150
M. C. Patterson†, D. Simkins, J. Beardall, V. Cummings, J. Pounder, R. Gale, K. Johnstone, D. Hamilton, G. Armitage†.
Rogers, Philips, Mullard, Amperex.
Receiving, transmitting, special purpose and picture tubes; speakers; capacitors; resistors; filters; ferrites and ferroxcubes.

Rutherford Agencies,
P. O. Box 1013, St. Laurent, Que.
Booth 535
E. D. Rutherford, D. A. Rutherford, W. C. Otto†, T. R. Rosser.
Cornell-Dubilier, Telequipment Ltd.
Capacitors, vibrators and vibrator power supplies; Serviscope general purpose 3 in. oscilloscope with automatic triggering.

Ryerson Institute of Technology,
50 Gould St., Toronto 1, Ont.
(IRE Student Associate Branch)
Booth 469
E. L. Kerridge† and 3rd year students†.
Display of laboratory projects for third year electronics students at Ryerson. The display will be centred around an interest-catcher in the form of a large-screen oscilloscope showing a moving outline of a human face.

Sensitive Research Instrument Corp.,
310 Main St., New Rochelle, N.Y.
Booth 532
Marvin I. Steinberg, Robert Most.
Self-checking laboratory standards, portable and panel-mounting ac-dc reference standards, polyrangers, millivoltmeters, voltmeters, microammeters, milliammeters, ammeters, fluxmeters, electrostatic voltmeters, thermocouple instruments, ac-dc volt-amp-milliammeter, differential incremeter, radio frequency voltmeter, crest voltmeter.

Sigma Instruments, Inc.,
170 Pearl St., South Braintree, Mass.
Booth 341
Donald Stewart, Frank H. Burridge, D. T. Shaw, F. H. Peters.
Sensitive relays — complete line, with emphasis on Series 32 and 33 subminiature DPDT magnetic latching or magnetic bias relays*. Series 111 development dc voltage adjustment "close difference" relay*. Electro-magnetic devices — particularly Cyclonome stepping motor and 60 cps and 400 cps magnetic amplifier relays*.

A. C. Simmonds & Sons Ltd.,
100 Merton St., Toronto 7, Ont.
Booth 250
David S. Simmonds, L. Claude Simmonds†, G. Douglas Pettifer, William A. Strangways, Richard C. Ferguson, Walter B. Campion, Robert J. McAuley.
Collaro, Curtis, Goodmans, Guardian, E. F. Johnson, P. R. Mallory, Ohmite Mfg., Shure Bros., Weiler Mfg.
New components* and equipment* representative of the latest developments achieved by the companies listed, including studio tape deck and transcription type record changers; types CT and RT and high-current terminal blocks; public address and 3-way hi-fi type loudspeakers; standard subminiature relays, small high reliability solenoids, and power relays; nylon connector components and Collett knobs; silicon rectifiers, tantalum capacitors, premium and computer grade electrolytic capacitors, small radio type electrolytics; variable transformer items and features; wire wound resistors; M7DM manufacturer's version stereo cartridge, Commando series microphones; soldering irons with magnetically controlled temperature feature.

Sinclair Radio Laboratories Ltd.,
21 Toro Rd., Box 179,
Downsview P.O., Ont.
Booth 537
P. Yachimec†, A. H. Secord†, W. V. Tilston, F. G. Buckles†, J. R. Richardson†, J. V. Hanson†, R. G. Sears, P. Castrucci.

Antennas for airborne and naval communications, filters, duplexers, antenna decoupler, antenna test set.

Sola Electric (Canada) Ltd.,
24 Canmotor Ave., Toronto 18, Ont.
Booth E8
Bob French, J. R. (Dick) McGovern, P.Eng.†, J. W. (Jim) Roe, Guy V. Fortier, P.Eng.
Sola Electric Co.
Constant voltage regulators; regulated dc power supplies, including transistorized designs*; regulated filament, and plate and filament transformers; control transformers*; saturable reactors*; compound magnetic dc power supplies*; portable regulated filament transformers*.

South Chester Corp., Southco Div.,
Lester, Pa.
Booth 364
H. J. Jordan, Lucien Boudrias, Jacques de Bellefeuille.

Special fastening devices for electronic equipment: stand-off thumb screws (retractable panel screws) from stock; Lion quarter turn fasteners, including miniature sizes*; specialty door, panel and drawer fasteners; Southco blind drive rivets. Fastener design services to handle unusual problems.

Spaulding Fibre of Canada Ltd.,
70 Coronet Rd., Toronto 18, Ont.
Booth 154
T. C. Drees, C. A. Dykeman, B. G. Orth, A. E. Robertson, B. Christensen, Geo. Holm, M. P. Komar.

Printed circuits, laminates, vulcanized fibre, fish paper, fibreboards, transformer pressboards, terminal boards, bushings, insulators, insulation, grommets, etc. New materials include Spauldite XXXP-793 high impact laminate*, Spauldite G-10-773 epoxy bonded laminate*, and E-XXXP-810 epoxy paper base laminate*.

Stark Electronic Sales Co.,
Ajax, Ont.
Booth 230
M. J. Stark, L. Samuel, C. Stoneman, A. Kasperski, G. Micklewright.
Stark Electronic Instruments, Science Electronics, Hickok, Anton, Shielding Inc.
Stark test equipment in kit and prewired forms, panel meters; Hickok test equipment for industrial and television use, tube testers, and panel meters featuring the new "taut band" suspension movement*; Anton rack and panel connectors, geiger mueller tubes, and nucleonic equipment; Shielding Inc. rf screened rooms.

Sterling Precision Corp.,
17 Matinecock Ave.,
Port Washington, N.Y.
Booth 262
Joseph F. Richards, Joseph Solari.

Precision magnetic clutches and brakes, differentials, precision gears (classes I, II and III and Ultra-precision), precision couplings, shafting, gear heads, speed reducers, breadboard components, electronic hardware, etc. New items include Size 8 clutches, gear head and limit stop*, and size 5 clutch and gear head*.

Strippit Tool & Machine Co.,
Hansen Rd., Brampton, Ont.
Booth 259
Ches Somerton, Al Duerksen, Jack Eimer, Howard Cartwright, Ted Rawlinson, Helmut Reichel.

Strippit Fabricator and the new Strippit Flexo-Drill*. Also a display of metal stampings, including electronic chassis.

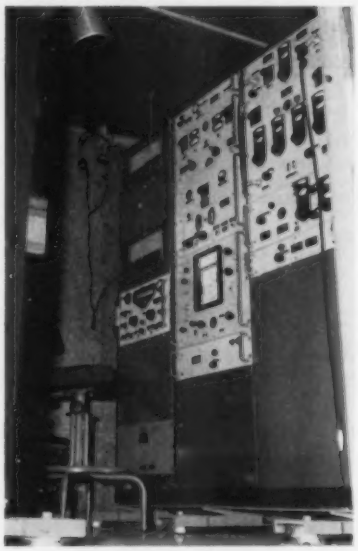
Sylvania Electric (Canada) Ltd.,
6233 Cote de Liesse Rd., Montreal, Que.
Booth 458
B. Holsinger, A. Lawruk, L. Murphy, P. Kolsinki.

DOT mobile monitoring laboratory

The Department of Transport has a new mobile monitoring laboratory to supplement its eight fixed monitoring stations across the country. Recently completed, it left Ottawa in August on a tour of Ontario and Quebec, and will arrive in Toronto in time to be on display in Booth 546.

Specially designed by E. W. Groves, radio regulations engineer with DOT, the unit comprises a tractor-trailer combination with its own power and heat supplies, 35-foot antenna and close to $100,000 worth of equipment. Officer in charge is Mr. E. H. Leaver.

The mobile laboratory is being used to check the transmission of radio and television stations across Canada. Its equipment, design and functions will be described in paper 9132 during Wednesday's session on communication equipment.



Sylvania Electric Products, Inc.
Feature of exhibit will be a new low cost closed circuit television camera*. Other items on display will include receiving, transmitting and special purpose tubes, magnetrons, cathode ray picture tubes and radar indicators, semiconductors, airport strobeacons and other lighting products.

T.M.C. (Canada) Ltd.,
R.R. No. 5, Ottawa, Ont.
Booth 242
D. V. Carroll, H. C. Ashdown, M. Yurko, H. Rowley, A. G. Sheffield, F. J. Rapp.
Technical Material Corp., Great Northern Telegraph Works.
Antenna multi-coupled AMC-6-5*, sideband transmitters SBT-1K* and SBT-350B*, sideband exciter SBE-2*, communications receiver GPR-90, sideband adaptor GSB, operating console CON, signal control unit SCU, general purpose transmitter GPT-750*, rhombic and dipole antenna couplers, quick disconnect antenna patch panels.

Tektronix, Inc.,
3 Finch Ave. E., Willowdale, Ont.
Booth 160
Scotty Pyle†, Bill Kladke†, Marvin Crouch†, Ray Lisiecki, Kermit Fleck, Udo Lindenmeyer.
Tektronix, Inc., Portland, Ore.
Several new model oscilloscopes, including type 555 dual X and Y, 30 mc* type 585 general purpose, 100 mc*; type 317 daylight portable, 10 mc*; type 321 transistorized battery operated portable, 5 mc*.

Tele-Radio Systems Ltd.,
3534 Dundas St. W., Toronto 9, Ont.
Booth 155
Ivor H. Nixon, John A. Fellows, George Scanlon (Tele-Radio); Geo W. Steck, Geo Constantine (Westrex).
Westrex Corp., Moore Associates, ERD/Du Mont, Railway Communications, Secode, Kaar Engr., Radio Specialists, Budelman, Radar Measurements, Hallamore, Northern Radio.
Fixed and mobile fm vhf and uhf radio, ssb radio terminals, facsimile terminals, radio teleprinter terminals, speech scrambling equipment, frequency meters, wattmeters, selective carrier voltmeters, Koiled Kords, control and alarm systems. New items include a transistorized hf 6-channel battery powered receiver*, vhf/uhf frequency meter for split channels*, transistorized high speed control and alarm systems*, 500-watt multichannel hf ssb terminals*, transistorized lf/hf radio-teleprinter receiver*, portable radar milliwattmeter and densiometer*, transistor powered ERD/Du Mont mobile radio units*, portable 450-mc fm radio set*.

Tellurometer Canada Ltd.,
1652 Carling Ave., Ottawa, Ont.
Booth 243
R. K. Rosebrugh†, J. B. Erskine.
Marvyn Instruments, Shaw Moisture Meters, Tellurometer (Pty) Ltd.
Marvyn chemical analysis equipment: square wave polarograph, infrared spectrometer, SO_2 recorder, etc. Also a portable transistorized potentiometer*. Shaw special purpose moisture meters, and a new indicating or recording hygrometer with extreme sensitivity*.

Telonic Industries, Inc.,
75 N. Second Ave., Beech Grove, Ind.
Booth 232
R. Q. Achzener.
Wide range of sweep and signal generators, with emphasis on radar and missile applications.

Texas Instruments Incorporated,
13500 North Central Expressway,
Dallas, Tex.
Booth 359
Tom Connors†, Murray Foster†, Herb Davidson, Henry Harris.
Milgray Electronics (TI distributor).
The world's broadest line of semiconductor products will be displayed for TI by Milgray Electronics Inc., including all of TI's "mesa" transistors, the new pnpn controlled rectifier*, and the industry's first general purpose germanium transistor selling for about 50c*.

Thomas & Betts Ltd.,
284 King St. W., Toronto, Ont.
Booth 455
N. M. Fishbourne, H. Green, S. Alcorn, R. Laffey, P. Gorouard, D. Byers.
Electrical and electronic cable terminal attaching machines, for insulated and non-insulated terminals, and including a new hopper-fed version*.

John R. Tilton Ltd.,
51 McCormack St., Toronto 9, Ont.
Booth 363, 365
J. R. Tilton, D. B. Black, H. W. Brieger.
Raytheon Canada Ltd., Sprague, Capital Machine, Osborne Electric, Sight Master, Standard Electrical Products, R. P. Scherer Ltd.
General and special purpose tubes, capacitors, switches, relays*, small indicating and non-indicating fuses*, variable transformers, Electrolube contact cleaner and lubricant.

Exhibits

Universal Winding Co.,
1655 Elmwood Ave., Cranston, R.I.
Booth 554
A. W. Wachta.
Coil and transformer winding machinery for the electronics industry.

Varian Associates of Canada Ltd.,
45 River Dr., Georgetown, Ont.
Booth 368
B. H. Breckenridge, J. G. Matthies†, M. Viant, G. M. Frost, R. R. Cricton, H. T. Sanderson, K. J. Lavell.
Varian Associates, Palo Alto, Calif.
Vaclon ultra high vacuum pumps, power amplifier klystron and reflex klystrons, graphic recorders. The new VA-824 two-resonator amplifier klystron using external cavity techniques will be featured*.

Ward Leonard of Canada Ltd.,
1070 Birchmount Rd., Box 70, O'Connor Postal Station, Toronto 16, Ont.
Booth W6
D. S. Brown, I. Mudrick, W. A. Wilson, W. R. Wilshire.
S.A.F.T. (France) Kepco Labs.
Ward Leonard resistors, relays, rheostats, motor controls, dimmers; S.A.F.T. nickel cadmium batteries, hermetically sealed button cells, Voltabloc batteries, Saftlight emergency lighting units, special applications of nickel cadmium batteries; Kepco voltage regulated dc power supplies.

Waterman Products Co., Inc.,
2445 Emerald St., Philadelphia, Pa.
Booth 169
See under Aviation Electric Ltd.

Wayne Kerr Laboratories Ltd.,
Chessington, Surrey, England.
Booth 264
Manufacturers of precision electronic instrumentation.

Wholesale Radio & Electronics Ltd.,
66 Orfus Rd., Toronto 19, Ont.
Booth 456
W. King, W. F. Saynor, D. Higgins, N. Giroux.
Ohmite, American Superior Electric, Honeywell-Micro Switch, P. R. Mallory, Hammond, Sprague, Potter & Brumfield, Struthers Dunn, Canadian General Electric.
Timers, relays, resistors, rheostats, capacitors, Powerstat and other transformers, switches, semiconductor devices.

A. C. Wickman Ltd.,
Box 9, Stn. "N", Toronto 14, Ont.
Booth 241
B. H. McGregor, D. W. Miller, W. H. McNeil.
Epsco-Worcester, Daytronic, Houston Instrument, Dynamic Instrument, Micro-Test, Telco.
Research, industrial and physiological recording systems and transducers. New items include modular recording systems*, two-channel hot stylus recorder*, and 1 mv/in. sensitivity X-Y recorder*.

John Wiley & Sons, Inc.,
440 Fourth Ave., New York 16, N.Y.
Booth 564
Rosemary Leap, Philip F. St. Pierre.
University of Toronto Press.
Professional level publications in those areas applicable to radio and electronics engineering.

The Wind Turbine Co. of Canada Ltd.,
145 Lucan St., Waterloo, Ont.
Booth W16
A. C. Veldhuist†, T. P. F. Henshall, N. Diehm.
TRYLON towers, communications antenna systems and components. A model of a recently installed Laporte rhombic transmitting antenna will be a feature of the display.

See these at the show

Latest developments will be on display

Many exhibitors will take advantage of the opportunity presented by this important exposition to introduce new components and equipment. Others will display products which have come onto the market since last year's show. Here is a cross-section of these new products compiled by the editors of CEE, to further help you plan your visit to the convention. If you can't attend the convention, but want information on the products, use the Reader Service Cards on pages 103 and 104.

Oscillographic recorder 138

The Massa recording oscillograph is a direct writing (ink or electric) recording milliammeter incorporating several new design features. Acoustic damping built into the vibrating system accomplishes a large degree of the damping, allowing any amplifier compensation required to be much less critical in adjustment. The oscillograph may be driven from a current source without a large peak in response at resonance. Model GA-1023 reproduces signals up to 200 cps and has a decimal speed changer with 3 speeds to a maximum of 200 mm per second.
Atlas Instrument Corp. Ltd. **Booth 350**

Drilling layout machine 139

Flex-O-Drill consists of a drill mounted on the cross arm of an accurate X-Y layout table. It was designed primarily to produce templates and layouts rapidly and to high standards of accuracy. It is a table type machine for drilling, reaming, centre punching and scribing. The working head can be positioned accurately by micrometer adjustments working in the X and Y directions. Accuracy is within ±0.002 inch. Capacity of the table is 24 x 24 x ¼ inches.
Strippit Tool & Machine Co.
Booth 259

Molded precision resistors 140

Three new sizes of molded, high stability, deposited precision resistors have been introduced by The Constanta Co. of Canada Ltd. Type N-5-M (Mil Spec type RN-70) is rated at ½ watt, 450 volts working. Resistance range is 10 ohms to 5 megohm in the 1% tolerance; 10 ohms to 10 megohms in the 2 and 5% tolerances. Type N-8-M (RN-65) is rated at ½ watt, 350 volts working. Resistance range is 10 ohms to 2.5 megohms for 1%; 10 ohms to 5 megohms for 2%; 10 ohms to 10 megohms for 5%. Type N-9-M (RN-60) is rated at ⅛ watt, 250 volts working. Resistance range is 10 ohms to 1 megohm at 1%; 10 ohms to 2 megohms at 2%; 10 ohms to 3 megohms at 5%.
The Constanta Co. of Canada Ltd.
Booth 146

Communications equipment 141

To complement their line of fm mobile radio-telephone equipment, International Systcoms have introduced a 30-watt, vhf fixed central station model SY30C. For remote control operation there is the

associated type SAC-1 station (illustrated).
International Systcoms Ltd. Booth 225

De-soldering tiplets 142

Special shaped Ungar tiplets help remove components quickly by melting solder on all terminals of a component simultaneously. Because they apply the right amount of heat only where needed, de-soldering tiplets avoid lug breaking, shorting and printed board rupturing. A variety of cups, triangles, bars, cube and slotted tiplets all fit the Ungar number 4045 heating unit.
Astral Electric Co. Ltd. Booth 338

Photoconductive cells 143

Cadmium sulphide and cadmium selenide photoconductive cells can be used in many applications in which an electrical circuit is to be controlled by light. These cells can be obtained in units having sufficient sensitivity to operate relays without additional amplifying circuits. They are available in a variety of package styles for particular applications.
National Semiconductors Ltd. Booth 134

Radar Densiometer 144

Ramcor model 1200 densiometer is a self-contained field strength meter specifically designed for monitoring radiation levels in areas where the use of high-power transmitters may create a hazard to personnel. The scale is marked "safe" and "danger" and is also calibrated in db with reference to 10 mw per cm^2. Pick-up antennas are available for all commonly used radar and communications bands from 200 mc up. Model 1200 can also be used as a field strength meter for tuning transmitters, detecting leaks in waveguides, etc.
Tele-Radio Systems Ltd. Booth 157

Packaged master control 145

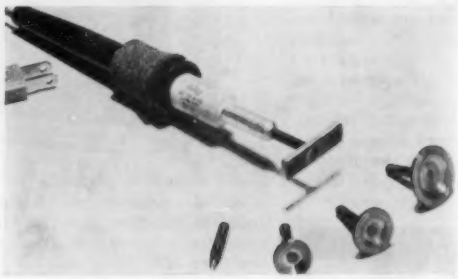
Model SS5000 packaged master control provides complete facilities for operating a small or medium sized radio station. With all units built in modular form and wiring ready to be plugged in, the control can be installed and placed in operation in about 30 minutes. Facilities include line, turntable, tape and microphone input. Two turntables are built into the control and can be supplied with two arms each as optional equipment. They are controlled from the central control panel and have automatic audio delay.

Plugs are provided so that two remote tape machines can be operated from the control console. Standard equipment is designed to operate a type 350 and type 601 Ampex recorder, but modifications can be provided to handle other types of recorder.

Amplifiers, preamplifiers, power supplies, and controls are built into the package to make it self-contained. It can function as the master control for 1 large

(Continued on page 76)

141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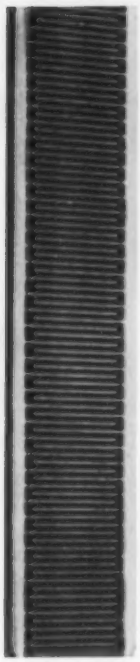
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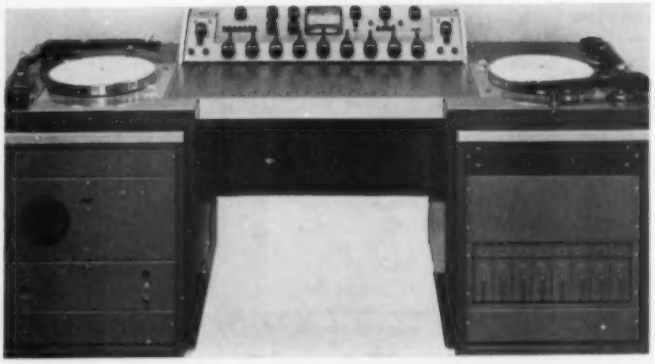


studio and two announce booths. Switching provides a variety of outputs and talk-back and foldback.
McCurdy Radio Industries Ltd.
Booth 245

Filament voltage regulator 146

The Canadian Division of C. P. Clare Co. has developed a filament voltage regulator for use in conjunction with vehicular and other electronic equipment where the heater supply for the vacuum tubes is obtained from a battery generating source. It uses a mercury wetted relay to switch a resistor in series between the input and output of the regulator. The relay is controlled by a resistance-capacitance network in such a manner that the time during which the resistor is in the circuit increases as the input voltage increases. This limits the effective heating value of the voltage applied to the load.

The regulator is designed to reduce input voltage surges of 40% above nominal to an input variation of less than 5% above nominal which is well within the operating design parameters specified by most tube manufacturers.

The relay is capable of handling loads up to 5 amps and 500 volts with the total load not exceeding 750 volt-amperes.
C. P. Clare Canada Ltd. Booth 246

DC high voltage tester 147

DC high voltage test set and wire sparker model DV-12V has an output that is continuously adjustable from 0-12,000 volts dc, filtered. It can be used either as a power supply or an insulation breakdown tester. In the latter case, two interchangeable plug-in relays permit rapid change of testing conditions. One relay provides operation in the range of 10 microamps to 5 milliamps. The other relay works in the range of 2-10 ma.

As a wire sparker, the tester can operate in two ways. It can be set so that when breakdown of the insulation occurs the high voltage testing voltage is turned off, a signal light is turned on, and the

wire transport is stopped. In the other mode of operation, the transport continues to function, but the fault is recorded on a counter and the high voltage reinstated after being shut off briefly.

Using dc for testing is a relatively new technique that permits more accurate testing with higher wire transport speeds and shorter testing trays than was possible with ac.
Canadian Research Institute. Booth E10

Three-gear differential 148

Featuring backlask of only 8 minutes and breakaway torque of 0.3 oz-in, miniature precision three-gear differential is applicable to electronic computers and fire control systems. Tumbling circle is 1.380 in. Maximum recommended load is 75 oz-in at 2500 rpm.
Dynamic Gear Co., Inc. Booth 336

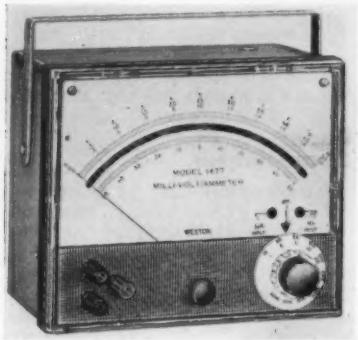
Portable test chamber 149

This 2.3 cubic foot cabinet is designed for test or thermal storage of small components and sub-assemblies under controlled temperature conditions. Conrad Temp-Rac 19 has a temperature range from —90 F to +300 F and requires only electricity for operation. It is portable and has a removable door with shelf assembly. The test area is a 16-inch cube.
Conrad, Inc. Booth 244

Milli-volt/ ammeter 150

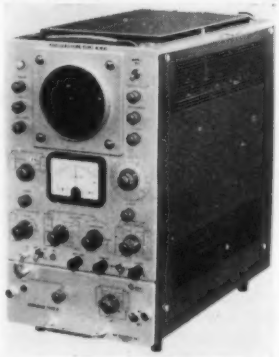
Available as a single compact unit, a new electronic milli-volt/ammeter, with zero drift comparable to permanent magnet moving coil instruments, has been introduced by Daystrom's Weston Instruments Div. Model 1477 is designed for the measurement and amplification of a wide span of direct currents and voltages ranging from 10 to 1,000 microamperes and 1 to 1,000 millivolts. Long-time drift can be maintained to less than 2 microvolts after a few minutes warm-up time.

The instrument uses a servo-amplifier whose high gain, coupled with feedback, provides accuracy and stability. Model 1477 has an accuracy of 2% on the lowest range and 1% on all others. Resolution capability is within 2 microvolts or 0.02 microamperes.



Daystrom Ltd. Booth E26

General purpose oscilloscope 151



Oscilloscope model WM8 is a general purpose instrument providing a wide variety of facilities which make it suitable for tv waveform analysis, pulse measurement, computer development and production testing. The amplifier has differential inputs with a common attenuator switch. The fine gain control enables any signal to be displayed at a convenient size on the 5 inch crt.

Bandwidth is dc to 15 mc (—3 db), sensitivity is 1 volt per cm using amplifier type 8.
E.M.I.-Cossor Electronics Ltd. Booth 142

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Impedance bridge 152

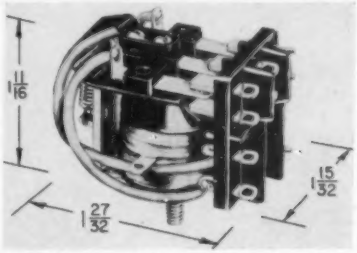
Model 1650-A impedence bridge indicates the measured quantities of R, L, C, Q, and D directly on dials with logarithmic scales. It is complete with built-in transistor oscillator and selective

detector. Resistance range is 0.001 ohms to 10 megohms. Capacitance range is 1 uuf to 1000 uf. Inductance range is 1 uh to 1000 h. Q range is from 0.02 to 1,000. D range is from 0.001 to 50. Orthonull mechanism makes practical the measurement of low-Q and high-D impedances by avoiding false nulls which give incorrect readings.

General Radio Company **Booth 152**

General purpose relay 153

Model KA, a small, general purpose relay is available with switching arrangements up to 3 pdt and can be furnished for ac or dc operation. Standard ac models are CSA approved. They are available for 6, 12, 24, 115, and 230 volt, 50/60 cps operation. The contacts are rated for 5 ampere, 115 volt, 60 cps resistive loads. The relay measures



1-15/32 in. wide, 1-27/32 in. long, 1-11/16 in. high, and weighs about 2 oz.

Potter & Brumfield Canada Ltd.

Booth 361

Modular delay lines 154

Essex Electronics epoxy-encapsulated modular delay lines are available for base mounting, stacked mounting, and printed circuits. Delay times available range from 0.05 usec to 7.00 usec. Delay tolerance at 50% pts is ± 10%. Rise time: 10% to 90% is 0.15 Td maximum. Impedance is 1000 ohms ± 10%. They conform to MIL T-27A class 2R.

A. T. R. Armstrong. **Booth 342**

(Continued on page 82)

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For your library

New text provides full story on programming business computers

Programming Business Computers

McCracken, Weiss and Lee; John Wiley & Sons, Inc., New York; 510 pp; $10.25

Reviewed by A. M. Lount, ENELCO Ltd., Toronto.

Messrs. McCracken, Weiss and Lee have written a very clear, concise and understandable introduction to the subject of "Programming Business Computers". While there is little information that will be new to those familiar with computers, the book is a must for someone new to the subject and is also worthwhile reading for anyone in this field, novice or expert.

This book is a worthy successor and supplement to Mr. McCracken's excellent book on "Programming Digital Computers". The emphasis this time, however, is more on the applications of computers to data processing, particularly to processing business problems. The book first deals briefly with data processing in general, continues through the elementary aspects of programming and coding, and devotes almost 50 pages to input output devices in programming, which is very important in such computer applications. Considerable space is used to discuss items such as magnetic tape programming, sorting, non-random access memories and large random access file storage.

The general approach is very much down-to-earth. Very much appreciated is the "data processing diary" in which the authors not only give a very accurate representation of what can happen on an actual job, but is very entertaining as well. The DATAC, a mythical computer system, is used to give a better understanding of detailed coding techniques in a manner similar to the TYDAC used by Mr. McCracken in his book.

There are very few programmers who could not benefit from a rereading of some of the fundamentals stated so clearly by the authors. The book is remarkable for the humility, clarity and pertinence of its remarks.

Circuit Analysis of Transmission Lines

John L. Stewart; John Wiley & Sons, Inc., New York; 183 pp; $5.50

Reviewed by N. Tomcio, Canadian General Electric Co. Ltd., EE&TD, Toronto.

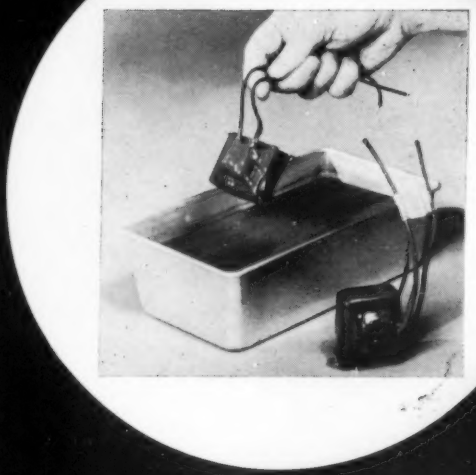
The author presents a comprehensive study of circuit elements with distributed parameters, i.e., elements consisting of sections of transmission lines for TEM mode transmission. In order to convey a deeper understanding of the phenomena involved, the author approaches the problems analytically, although the important graphical methods are also treated.

The first three chapters deal with the transient phenomena while the fourth chapter is devoted to the steady state theory.

After the introduction into the transmission line theory, the application of transmission line sections of various forms as circuit elements is analyzed in the next three chapters dealing with impedance matching, resonators and filters. The latter subject is evolved in an analogy to the equivalent lumped circuits. It seems to be appropriate that in this chapter the power lines and the power circle diagram are also discussed.

In the circuit analysis no approximations are made and the transmission losses are retained in the mathematical treatment.

The last two chapters are devoted to the practical aspects of the distributed parameters circuit analysis. One of them deals with the measuring techniques, in particular of such quantities as standing wave ratio, impedance, characteristic impedance, line discontinuities, attenuation and circuit Q. The last chapter introduces the graphical methods for the solution of transmission line problems and the description as well as application of the Smith Chart. An extensive list of references included in the Introduction will



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definitely be appreciated by a reader who wants to pursue the subject further.

Circuit Analysis of Transmission Lines should prove to be an excellent textbook for an engineering student as well as a useful tool for a designer. It represents a good balance between the theoretical aspects necessary for the understanding of the transmission line phenomena and practical aspects of the application of the theory to design problems. It is only regrettable that the author limited his subject to only one type of transmission mode, i.e., TEM or basic mode while transmission media (waveguides) for higher modes have not been included. It is recognized that the tools and analytical methods differ to a considerable extent, however, the problems are very closely related and from the standpoint of a designer both types serve the same purpose. It is only a matter of application frequency which decides what type of the transmission medium has to be used. There is a definite need for a similar textbook on waveguides which, after all, are only another type of transmission line.

Radar Meteorology

Dr. Louis J. Batten, associate director of the Institute of Atmospheric Physics at the University of Arizona is the author of a new book on radar meteorology. The 172-page book is directed to practising meteorologists, teachers, electronics engineers, and research workers. It traces the history of radar meteorology since its birth during World War II. The book has been published by the University of Chicago Press.

Radio Communications

W. F. Lovering; Longmans, Green & Co., Toronto; 536 pp; $10.80

Reviewed by F. Ford, P.Eng., Canadian General Electric Co. Ltd., EE&TD, Toronto.

Based on undergraduate degree course lectures, this is a highly organized text presenting elementary fundamentals of radio communication theory in one volume at attractive physical size. Early chapters assume elementary ac theory knowledge and some acquaintance with differential calculus. Later chapters assume some improvement in mathematical attainment. Rationalized mks units are expressed, defined and adhered to throughout.

It begins with a summary on electrical theory, and moves logically through tuned circuits, ac filters and attenuators, transformers, sound reproduction, radio transmission and reception, tubes, amplifiers, oscillators, detection, modulation, transmitter and receiver circuits, power supplies, transmission lines, antennas, radiation, time bases, transistor amplifiers.

This is a good supplementary text for the undergraduate engineering student wanting a parallel text to broaden his elementary university study. Its excellent index makes it a good reference for the practising engineer who realizes only too often that his fundamental training was probably the weakest part of his learning.

The text is neat: proofs are relegated to the appendix and carefully chosen problems are stated briefly (with answers) at the end of the text.

Of course there is the endless translation of anodes, aerials and valves, but this only reminds us of the valuable contribution being made to the literature from outside our country.

International Electrotechnical Commission Standards

Three new publications of IEC are available through the American Standards Association. They concern capacitors, resistors, and measurement of rf radiation.

IEC Publication 106 ($3.60), Recommended Methods of Measurement of Radiation from Receivers for am, fm, and tv Broadcast Transmission, describes standardized methods of test for determining rf radiation from receivers.

IEC Publication 108 ($3.20), Recommendations for Ceramic Dielectric Capacitors Type I, lays down uniform requirements for judging the mechanical, electrical, and climatic properties of fixed ceramic dielectric capacitors of a type specifically suited for resonant circuit applications.

IEC Publication 109 ($3.20) Recommendations for Fixed Non-Wirewound Resistors Type II, applies to fixed resist-

(Continued on page 81)

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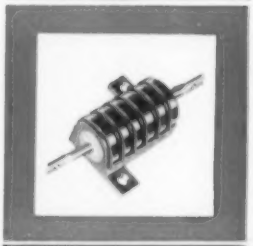

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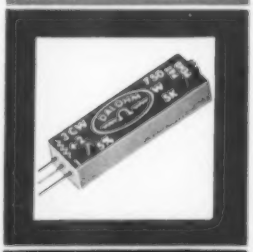

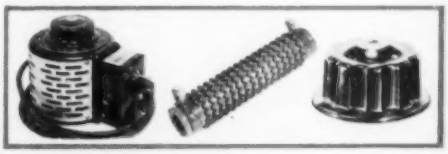

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Defence contracts

Unclassified electronics contracts for $10,000 or more have been awarded to the following Canadian firms by the Department of Defence Production. A figure in parenthesis indicates the number of contracts, the amount being the total value.

July 16-31, 1959

Bell Telephone Co. of Canada, Ottawa, technical services, $17,685.

Canadian Applied Research Ltd., Ottawa, spares for radar equipment, $40,777.

Canadian General Electric Co. Ltd., Toronto, spares for radar equipment, $87,165.

Canadian Marconi Co., Montreal, signal generators, $130,592 (2); communication equipment, $406,653 (2); research contract, $24,967.

Canadian National Railway Co., Ottawa, rental of telephone facilities, $12,816.

Canadian Renner Consultants Ltd., Montreal, trainer testers for radio, $12,766.

Collins Radio Co. of Canada Ltd., Toronto, radio equipment, $154,388.

Computing Devices of Canada Ltd., Ottawa, equipment, $24,729.

Electronic Laboratories of Canada Ltd., Vancouver, repair and overhaul of ground and airborne equipment, $10,000.

Electronic Materiels International Ltd., Ottawa, repair and overhaul of equipment, $46,360.

E.M.I. - Cossor Electronics Ltd., Halifax, equipment, $44,045.

E. P. Electric Products Co. Ltd., Montreal, installation of radio equipment, antennae and associated accessories, $33,640.

RCA Victor Co. Ltd., Montreal, research contract, $35,959, technical services, $30,716.

Sparton of Canada Ltd., London, Ont., sonobuoy equipment, $199,909.

Standard Telephone & Cables Mfg. Co. (Canada) Ltd., Montreal, cryptographic equipment, $19,489.

Technical Service Laboratories, Toronto, spectrograph and accessories, $14,565.

August 1-15, 1959

Bell Telephone Co. of Canada, Ottawa, technical services, $31,970 (2).

Canadian Aviation Electronics Ltd., Montreal, mobile test equipment calibration, $33,079; technical services, $66,014; installation and calibration of flight and instrument procedure trainers, $24,614; cleaning and recoating of radomes, $11,057.

Canadian Marconi Co., Montreal, tubes, $29,400.

Canadian Westinghouse Co. Ltd., Ottawa, tubes, $180,360.

Computing Devices of Canada Ltd., Ottawa, technical services, $14,400.

Hillas Electric Co. Ltd., Edmonton, Alta., provision and installation of telecommunication cable $96,990.

RCA Victor Co. Ltd., Montreal, study contract for central test position, $12,000.

Library—continued

ors of types other than wirewound, with a rated dissipation not exceeding 3 watts and a rated resistance value between 10 ohms and 22 megohms, suitable for use in circuits where high stability of the resistance is not of major importance.

All IEC publications may be obtained from the American Standards Association, Dept. PR 95, 70 East 45th Street, New York 17, N.Y. Prices quoted are U. S.

Applications and circuit design notes

Solid State Products, Inc., Salem, Mass.

This company has prepared a series of publications giving application and circuit design information on solid state devices such as trigistors, silicon-controlled switches and silicon-controlled rectifiers. Booklets range up to 30 pages in length.

Also available is a 17-page reprint of four papers titled "How to design for transistor reliability".

Microminiaturization

Hayden Publishing Co., Inc., Book Div., 830 Third Ave., New York 22, N.Y.; 300 pp; $8.50 (Limited time introductory price).

This is a collection of 21 papers that describe the progress in electronic techniques, components, circuits and semiconductors that are expected to shrink radio, tv, computers, missiles and space vehicles to a tiny fraction of their former size. The papers were originally presented at the Diamond Ordnance Fuze Laboratories' symposium on the microminiaturization of electronic assemblies.

The Audio Cyclopedia

Howard M. Tremaine; (Howard W. Sams & Co., Inc., publisher) Alex L. Clark, Ltd., Toronto; 1,280 pp; about $23.50.

This compendium of applied audio gives information on all subjects in the field of acoustics, recording and reproduction, with a quick-reference indexing system. It's 26 sections include basic principles of sound; acoustics and studio techniques, constant speed drives; amplifiers; styli; audio frequency measurements; and other subjects. There are 3,400 topics and 1,600 illustrations.

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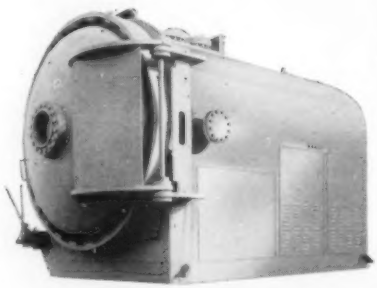

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New products at the show

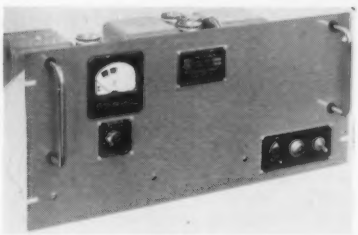
Closed circut TV 155

This low priced closed circuit tv camera measures 12 in. long, 7 in. wide and 6 in. high. It uses 250 to 300 line resolution for presentation on a standard tv receiver monitor. It uses a vidicon pickup tube and has an output of 0.05 volts into 70 ohm coaxial cable equipped with 70-300 line matching transformer. Frequency range is 2 to 6 channels. There is a 4 lens turret and power consumption is 50 watts at 105-128 volts, 60 cps.

Sylvania Electric (Canada) Ltd. **Booth 458**

Antenna multicouplers 156

Antenna multicouplers type AMC-6 are broadband devices designed to couple a number of receivers to a single receiving antenna. They cover the frequency range 15 kc to 30 mc and provide an effective match with a minimum of interaction between receivers, and a minimum of intermodulation and cross

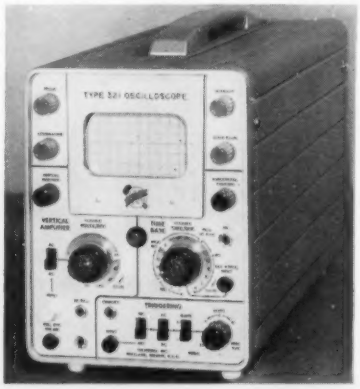


modulation. Any of the units may be used in cascade operation to get up to 36 outputs from a single antenna.

T.M.C. (Canada) Ltd. **Booth 242**

Portable oscilloscope 157

Model 321 transistorized portable oscilloscope operates from ten high-current D size flashlight cells, or ten rechargeable D cells (approximately 3 hours), or 11 to 35 vdc (aircraft, auto, boat, etc.), or 105 to 125 v or 210 to 250 v, 50 to 800 cps.



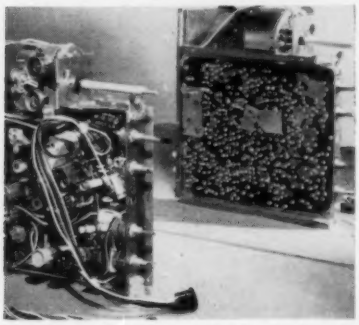
Passband is dc to 5 mc on the vertical amplifier, risetime is 0.07 usec; sensitivity is 0.01 v/div. to 20 v/div. in eleven calibrated steps, continuously variable from 0.01 v/div. to 50 v/div.

Calibrated sweeps are 0.5 usec/div. to 0.5 sec/div. in 19 calibrated steps. Accurate 5-x magnifier extends calibrated range to 0.1 usec/div.

Tektronix Inc. **Booth 160**

Paper base laminate 158

A new paper base laminate, XXXP-793 has been designed for use where impact problems call for a material stronger than standard XXXP grades. It uses a reinforcing ply to obtain an Izod impact strength greater than four times



that of NEMA grade XXXP. Its impact strength makes it suitable for use in printed circuit applications. It is fabricated in parts, sheets or copper clad.

Spaulding Fibre of Canada Ltd.
Booth 238

Calibration standard 159

Radio Frequency Laboratories model 1605 ac-dc calibration standard is a precision ac and dc voltage and current measuring instrument. Incorporated into the equipment is a volt box, shunt box, precision potentiometer, standard cell, galvanometer, thermal converter and all necessary compensating circuits, switching and accessories necessary for self-contained operation.

Instronics Ltd. **Booth 553**

Shielded audio cable 160

Belden Manufacturing Co. is featuring a new shielding called Belfoil which is used in their sound and intercom cables. It permits the use of completely isolated, individually shielded and jacketed pairs in a light-weight, small-diameter, multi-conductor cable. Space and weight savings are obtained by combining conductivity properties of aluminum foil with high dielectric properties of Mylar. Belfoil is constructed with an overlap to insure complete shield isolation and a ground wire to eliminate cross-talk and external interference. Type 8764 has 9 pairs of 22 AWG solid; type 8766 has 15 pairs of 22 AWG solid. Both are available in 100, 500 and 1,000 foot spools.

Belden Manufacturing Co. **Booth 533**

(Continued on page 84)

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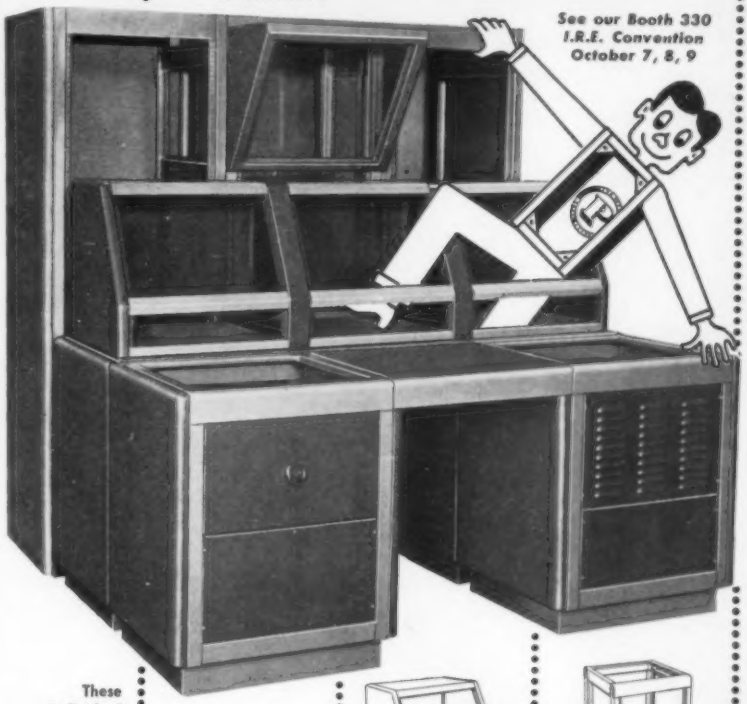

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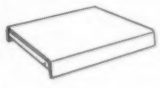
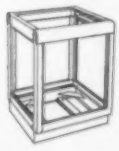
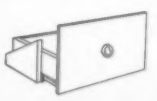


WORK TOP

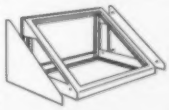
SLOPING CONSOLE CABINET



PEDESTAL FRAME



SLIDING DRAWER



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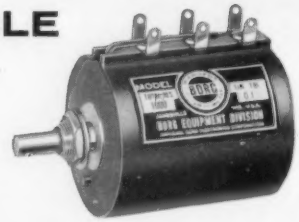

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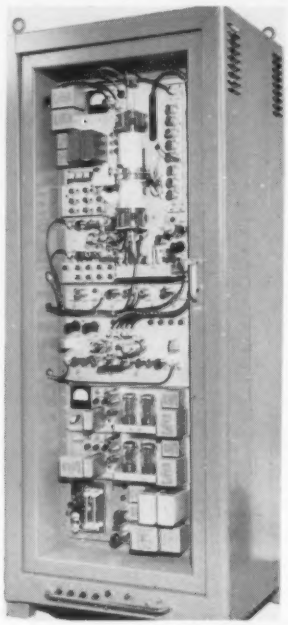
New products at the show

Radar to TV scan converter 161

On this radar to tv scan converter for bright display systems, radar ppi signals are written into a double-gun electrostatic storage tube where they are retailed as a pattern of electric charge

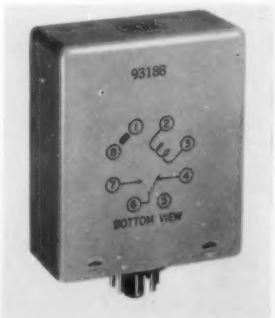


which fades at a controlled rate (typically in one minute). The charge is read off by a tv raster, so that the scan converter gives a 525-line, 30 frame tv signal. A standard tv monitor, connected to the scan converter, becomes a daylight viewing ppi with adjustable persistence. Aircraft targets leave trails which indicate at a glance both position and direction of travel.

Raytheon Canada Ltd. **Booth 367**

Differential relay 162

Series 111 close differential relay is a developmental relay designed for monitoring and controlling voltages in automatic battery chargers, power supplies, etc. Release voltage can be as high as



95% of operate voltage. It can be used on 6, 12 or 24 volt operation. Octal plug-in mounting is standard.
Sigma Instruments, Inc. **Booth 341**

Taut-band meter movements 163

Hickok taut-band suspension is being utilized in panel and other meters to provide sensitive movements without the use of conventional pivots. Two fine wires act as torsion bars to provide mechanical characteristics that will meet or exceed MIL specification. They have extremely long life, can be built for ratings as low as 0.5 microamperes and still give a steady indication. The movement is critically damped. It can withstand excessive overloads — 5 times full scale indefinitely, 300 times full scale in surges.
Stark Electronic Sales Co. **Booth 230**

Modular console cabinets 164

Prem-O-Rak console cabinets can be assembled in a variety of ways from

modular pedestals, racks, sloping cabinets. shelves, sliding drawers and panels. Almost any type of installation can be built up to suit customer requirements.
Premier Metal Products. **Booth 330**

Breadboard kits 165

A series of master breadboard kits has been developed in precision 1, 2 and 3 tolerances. Available in ⅛, 3/16 and ¼ inch shaft diameters, the kits contain over 2,000 different items, such as gears, speed reducers, differentials,

limit stop assemblies and other components adaptable to mechanical and electronic applications.
PIC Design Corp. **Booth 235**
(Continued on page 88)

ROTARY multi-pole multi-circuit SWITCHES

TYPE JL

TYPE MA-12

FOR ELECTRIC CIRCUITS:

TYPE JL rotary switch is a low-power switch with an electrical rating of 5 amperes, 125 volts a-c. A maximum of eight positions — up to ten sections — are controlled by a single knob. This type permits unlimited rotation in both directions but can be limited to any number up to eight positions by two stop screws. It is designed for single-hole panel mounting. Meets MIL-S-21604 and BuShips Drawing Number 9000-S6202-74422. Write for free Bulletin 101-A containing comprehensive data.

FOR ELECTRONIC CIRCUITS:

Type MA-12 is a miniature rotary switch with an electrical rating of 3 amperes, 115 volts a-c. With a maximum of 12 positions, rotation can be unlimited in both directions or can be limited from two to twelve positions. Also available with up to six poles per section and a total of five sections controlled by a single knob. This type rotary switch is ¾" square, for single-hole panel mounting. Moulded of MAI-60 per MIL-M-14E; designed to meet MIL-S-3786.

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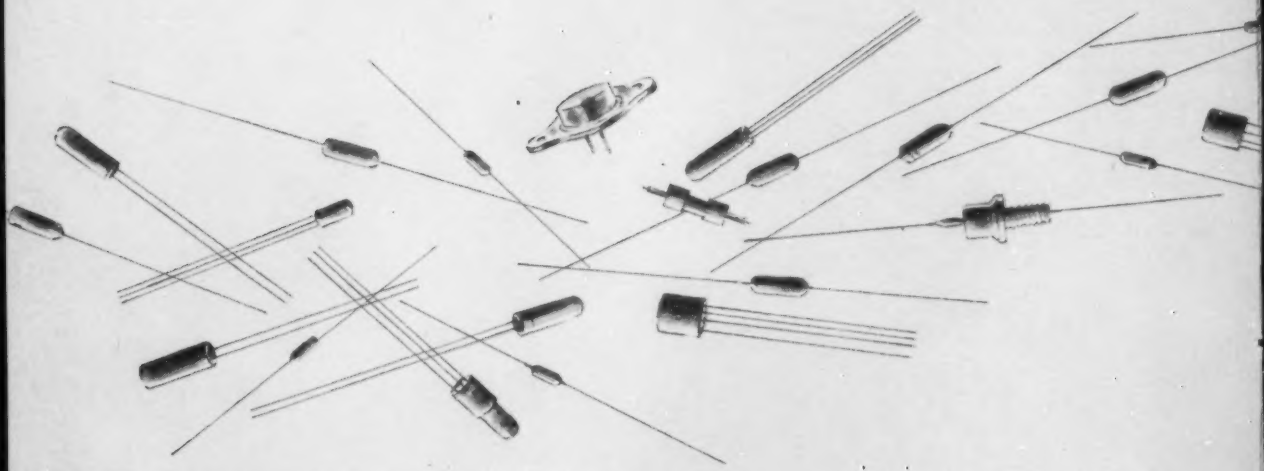

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Germanium Audio Frequency

OC70	General purpose BETA = 30
OC71	Medium gain BETA = 41
OC72	Low power audio output
2-OC72	Matched pair of OC72
OC73	Close tolerance medium gain
OC74	Medium power audio output
OC75	High gain BETA = 90
OC76	Low power switching
OC77	High voltage switching
OC80	High current switching

Germanium Audio Frequency Power

2N1314	37 watts dissipation BETA = 45
2N1315	37 watts dissipation BETA = 85
OC28	37 watts dissipation High Ic, High Vc
OC29	37 watts dissipation High Ic, High Vc
OC30	4 watts dissipation
2-OC30	matched pair OC30
OC35	37 watts dissipation High Ic
OC36	37 watts dissipation High Ic

Germanium High Frequency Power

OC22, OC23, OC24	10 watt dissipation at 2.5 Mc/s.

Germanium Phototransistor

OCP71	General purpose phototransistor

Silicon Junction

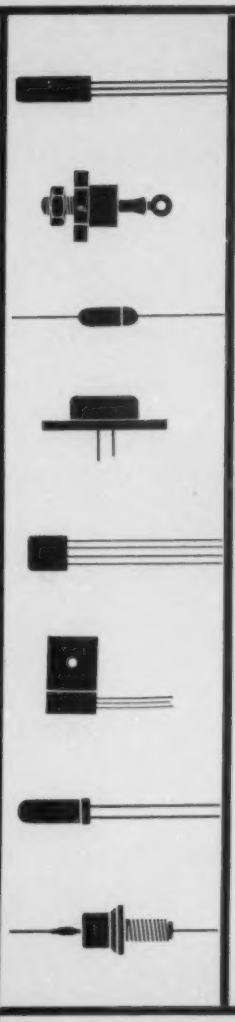
OC200	General purpose—P-N-P
OC201	General purpose BETA = 30 P-N-P
OC203	High voltage, medium gain. P-N-P

Germanium Radio Frequency

OC44	Converter for broadcast receivers f_{co} 15.0 Mc/s.
OC45	I.F. amplifier for broadcast receivers f_{co} 6.0 Mc/s.
OC46	High speed switching transistor f_{co} 3.0 Mc/s.
OC47	High speed switching transistor f_{co} 4.5 Mc/s.
OC139	Symmetrical N-P-N switching transistor
OC140	Symmetrical N-P-N switching transistor
OC141	Symmetrical N-P-N switching transistor
OC169	High frequency alloy diffused transistor
OC170	High frequency alloy diffused transistor
OC171	High frequency alloy diffused transistor

Germanium Subminiature

OC57	General purpose subminiature
OC58	General purpose subminiature
OC59	General purpose subminiature
OC60	General purpose subminiature output amplifier



DIODES AND RECTIFIERS

Germanium Junction Rectifier

OA31	Medium current power diode I = 3.5A

Silicon Junction Rectifiers

OA210	I max. 0.5 A P.I.V. 400
OA211	I max. 0.4 A P.I.V. 800
OA214	I max. 0.5 A P.I.V. 700

Silicon Zener Diodes

OAZ200 to OAZ207	Voltage range 4.7—9.1 V ±5%
OAZ208 to OAZ213	Voltage range 4.2—12.2 V ±15%

Silicon Junction Diodes

OA200	P.I.V. 50 V. I max. 50 mA
OA202	P.I.V. 100 V. I max. 30 mA

Germanium Junction Diode

OA10	Low hole storage computer diode

Germanium Gold Bonded Diodes

OA5	P.I.V. 100 V. General purpose switching.
OA7	P.I.V. 25 V. High speed switching.
OA47	P.I.V. 25 V. High speed switching.
1N281	P.I.V. 75 V. High conductance diode.
1N760	P.I.V. 60 V. Extremely fast recovery diode.
1N788	P.I.V. 60 V. Extremely fast recovery diode.

Germanium Point-Contact Diodes

OA70/1N87	Video detector.
OA72	High frequency diode.
OA73/1N616	Industrial diode.
OA79/1N541	a.m. and f.m. detector.
2-OA79/1N542	Matched pair OA79/1N541.
OA81/1N476	High voltage general purpose.
OA81C/1N477	Clip-in version of OA81/1N476.
OA85/1N478	High voltage general purpose.
OA85C/1N479	Clip-in version of OA85/1N478.
OA86/1N480	Low hole storage computer diode.
OA86C/1N119	Clip-in version of OA86/1N480.
OA90/1N87A	Subminiature video detector.
OA91/1N617	Subminiature OA81/1N476.
OA95/1N618	Subminiature OA85/1N478.
1N126	Subminiature JAN diode.
1N198	Subminiature JAN diode.

This reference sheet is the second in a series from Rogers to keep you informed of electronic developments. A specially designed file folder for these bulletins is available from Rogers on request.

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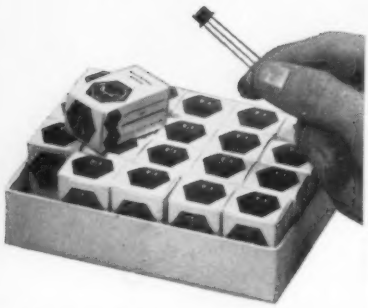

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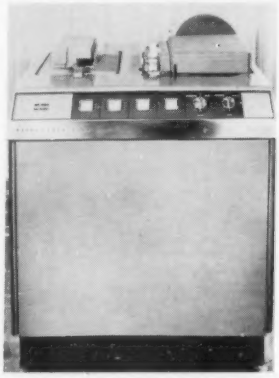
New products at the show

High speed reader — 166

The high speed reader is designed to read information from punched paper tape into the LGP-30 computer. Use is made of photoelectric cells which give rise to electrical signals when energized by light passing through holes in the

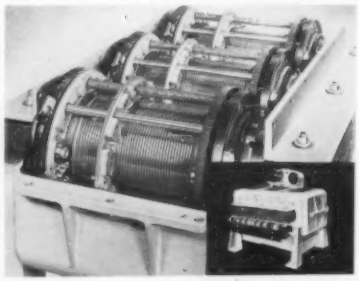


paper tape. An input speed of twenty times that of the electric typewriter makes the photo reader desirable for any LGP-30 which is required to handle large quantities of data on frequent changes of program.

The McBee Company Ltd. Booth 329

Variable power transformers — 167

Powerstat variable transformers of the H-C series feature high current ratings and performance characteristics not possible with toroidal wound types. Re-entry rings and helical coils permit continuously-adjustable control of 1600 increments over the range of zero to maximum output voltage. Resolution is better than 0.1% of the input voltage.



Two types are available, both remotely operated from a control unit mounted either on the powerstat frame or at any other convenient location. With an input of 240 volts, 60 cps, 3-phase, the convection type has an output rating of 0-270 volts, 200 amperes, 93.5 kva. The forced air cooled type has an output rating of 0-270 volts, 360 amperes, 168 kva.

The American Superior Electric Co. Ltd. Booth 136

(Continued on page 90)

Completely **CANADIAN MADE**

PANEL MEASURING INSTRUMENTS

PORTABLE AND LABORATORY INSTRUMENTS

ELECTRONIC INSTRUMENTATION

Only a complete Canadian instrumentation facility can offer the kind of service Canadians need. Bach-Simpson Ltd. *is* complete — in research, design, tooling and manufacture.

If our standard line of instruments, complete as it is, won't meet your requirements, ask us to demonstrate the unique combination of skills we can offer in the design of specialized instrumentation to meet your specific problem.

Others have, and have been completely satisfied!

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For further information mark No. 17

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Best of all — a **new low price** making the finest in measurement available to all sizes of pocket books — all made possible only by complete **Canadian** manufacture.

RANGES:

D.C. Current. From 50 Microamps to 10 Amps in 6 ranges.

D.C. Volts (20000 ohms/volt). From ¼ volt to 5000 volts in 7 ranges.

A.C. Volts (5000 ohms/volt). From 2.5 volts to 5000 volts in 6 ranges.

D.C. Resistance 0-2000 ohms to 0-20 megohms in 3 ranges.

Polarity reversing switch, volume level (decibel) and DBM ranges.

Price — tax included **$55.00**

The long tradition of fine instrumentation of the Model 260 is now extended to the custom-engineered Model 270, providing increased accuracy, a mirror scale and movement overload protective service, along with full per- details. Priced at $63.07.

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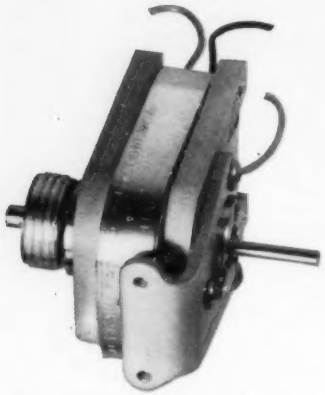
... IN 18° JERKS, UP TO 300 JERKS A SECOND



The Cyclonome®
(a stepping motor):

— a device with wires going in and a shaft sticking out.

— looks like a primitive electric motor.

— ratchets magnetically. Has only one moving part, supported by ball bearings.

— runs by alternating magnetic field (variously produced by juice in the wires) in even, powerful jerks, 20 per revolution.

— if hooked up right, according to the dope in our new Bulletin, the number of 18° steps will forever be the same as the number of pulses sent down the wires.

— go by the rules, and you can produce analogs on precision pots or capacitors, find places on magnetic tape or numbers on coding discs, get high speed multi-throw switching, index movie film, or just count bits on drum counters at speeds not otherwise possible.

There are also other things you could do with this motor, we hope, and here is what you have to work with. The Cyclonome has 20 stable positions or 20 steps per revolution . . . a max. torque of 80 gm-cm . . . an inertia of 0.7 gm-cm² . . . a max. pulse rate of 300 pps with pure inertia load of 1 gm-cm² or pure friction of 40 gm-cm. Circuit power requirements range from ⅛ to 40 watts depending on speed and load. Physically, the motor measures about 1⅜" x 2½" x 1¾" high (except for the shaft) and weighs about 11 ounces.

If your curiosity has now been aroused, we'd be delighted to send you the new Bulletin and tell you whatever else we might know about applying the Cyclonome to your application.

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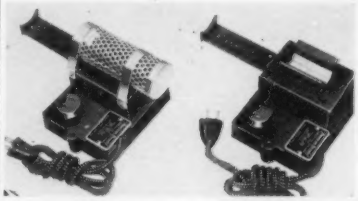
New products at the show

Temperature regulating stands 168

These are devices for regulating and controlling the tip temperature of an electric soldering iron while the iron is connected to current and at idle. Model 475 is designed for use with electric soldering irons from 80 to 660 watts input. Model 476 is for irons from 30 to 75 watts input.

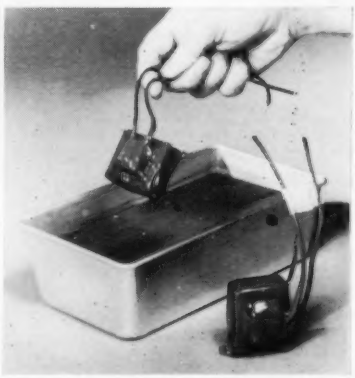


The SG models are equipped with heavy-gauge perforated steel guards over the cradle of the stand to prevent accidental burns from touching the hot irons.
American Electrical Heater Co.
Booth 558

Epoxy dipping compounds 169

A new line of epoxy dipping compounds with long pot life and very high thermal shock resistance has been introduced. Hysol 11-57, used for dipping larger transformers and chokes, has excellent thermal ageing characteristics and is suitable for use in ambient temperatures ranging from —65 to +135 deg. C.

Another new product is epoxy molding powder Hysol 86-10, for compression molding of capacitors and resistors.
Hysol (Canada) Ltd. **Booth W4**



Amateur equipment 170

A new line of amateur transmitting and receiving equipment has been introduced. The S-line ssb/cw equipment includes the model 75S-1 receiver, the 32S-1 exciter/transmitter and the 30S-1 amplifier.
Collins Radio Co. of Canada Ltd.
Booth 551

(Continued on page 92)

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in Small Panel Instruments

The General Electric dramatic BIG LOOK in small panel instruments gives you excellent readability plus reliable operation in a truly distinctive design. These new, competitively priced instruments provide up to 28% increase in scale length, yet fit into the same space as ordinary instruments.

All instruments are self shielding and can be mounted on magnetic or nonmagnetic panels with no loss of accuracy.

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INDUSTRIAL PRODUCTS DEPARTMENT

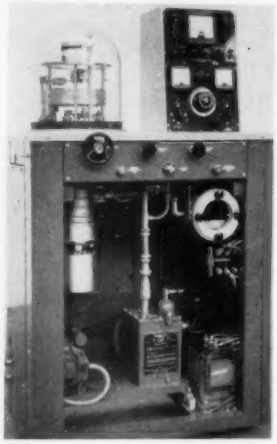
CANADIAN GENERAL ELECTRIC COMPANY LIMITED

For further information mark No. 27

New products at the show

Vacuum coating unit 171

Model 12E6 coating unit supplies fast pump down time to 10-6 mm of Hg and is suitable for laboratory or production use. A 4 inch Speedivac vapour diffusion pump backed by a 5 cfm mechanical rotary pump provides fast pump down times of the 12 inch diameter bell jar. A ballast tank is located in the backing line allowing the rotary pump to be shut down, which lets coating be carried out in a vibration-free atmosphere. The ballast tank can also be used as a desiccant



trap or for dry atmosphere specimen storage. It is fully valved and instrumented including ht ionization cleaning and safety devices.

Edwards High Vacuum (Canada) Ltd.
Booth W22

Portable oscilloscope 172

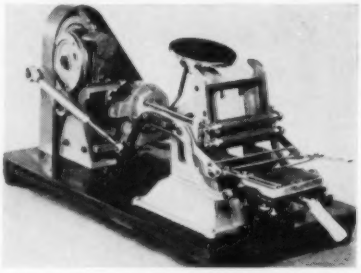
The Waterman direct reading Pocketscope Hi-Gain Model S-17-A allows direct calibration of scale in volts (from 10 millivolts per division) and milliseconds (from 10 microseconds per division). Sync signal in excess of 1 volt peak

automatically triggers the oscilloscope. Sync light indicates presence or absence of proper level. Single switch flips trace 90 degrees to increase accuracy for voltage measurements giving effective 2½ inch vertical.

Aviation Electric Ltd. **Booth 251**

Printing press 173

Designed for printing flat or round objects and objects with uneven surfaces, Model B3/FRV dry offset printing press can be used for a range of sizes from tiny resistors and capacitors to objects as large as a gallon can. Imprinting is possible on metal, glass, wood, fibre and plastics. The machine is fitted with a quarter horsepower motor to provide variable speeds up to 2,000 imprints per hour. It uses metal and rubber type and



plates. This model is being used for printing radio and tv tubes, light bulbs, capacitors, resistors, fibre and metallic parts.

Canada Stamp & Stencil Co. Ltd.
Booth 256

(Continued on page 94)

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COMMUNICATION MASTS

for AM-FM Broadcasting
HF-VHF-UHF Communications
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Please send complete information on the following masts I have checked.

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☐ PORTABLE ALUMINUM MASTS for heights up to 150 feet.
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We will design and manufacture custom made masts and towers to suit your specific requirements.

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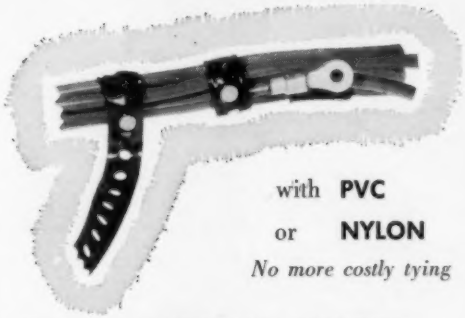

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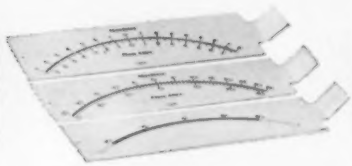
BRUEL & KJAER MODEL 1504

DEVIATION BRIDGE



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- **High stability allows adjustment-free operation**

These bridges operate on carrier frequencies of 100 cycles, 1 kilocycle, 10 kilocycles or 100 kilocycles.

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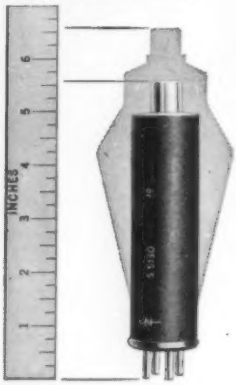
TYPE S-5130 SILICON RECTIFIERS



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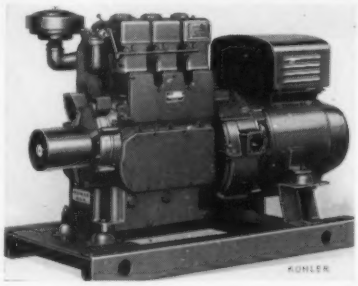
For further information mark No. 71

New products at the show

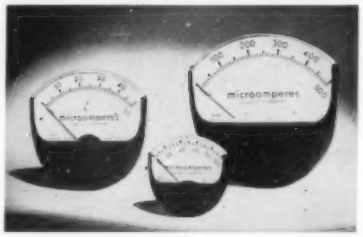
Diesel generator 174

Three new air cooled diesel generating plants have been introduced by Kohler Co. They are rated at 2, 5 and 7.5 kw and are available with manual, remote, or push-button starting, and with various ac output voltages.
Geo. W. Crothers Ltd. **Booth 133**



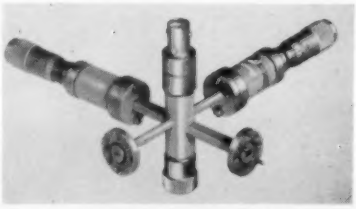
Panel meters 175

Marion Medalist meters — ammeters, voltmeters, VU meters and null indicators — are panel instruments of advanced design, providing greater readability and modern styling in minimum space. Available in 16 standard case colors, or custom colors to match customer equipment.
Honeywell Controls Ltd. **Booth 351**



Millimeter wave components 176

Recent advances in physical research have created an interest in the highest attainable microwave frequencies — an interest which requires the use of millimeter wave components and instruments. De Mornay-Bonardi is introducing instruments and components for the W size—90 to 140 kmc. Included are transmission line components, detectors, power absorbing units, horns, tees, frequency meters, impedance meters, phase shifters, shorts, tuners and accessories.
Bayly Engineering Ltd. **Booth 247**



(Continued on page 97)

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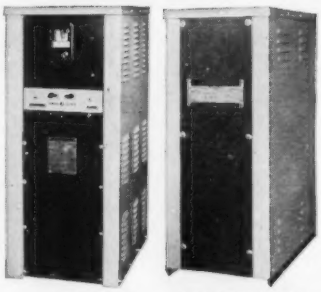
Drift-free, Distortion-free, Stepless Voltage Regulation



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Other Inductrol regulator controls can be furnished to hold a constant current *or* voltage, either a-c or rectified a-c. Inductrol regulators of dry-type construction are available for circuits up to 600 volts. Liquid-filled Inductrol regulators are available from 2400 to 13,800 volts.

For further information, call your local C-G-E Sales Office, or write: Section 425-17, Apparatus Department, Canadian General Electric Co., Ltd., PO Box 601, Guelph, Ontario.

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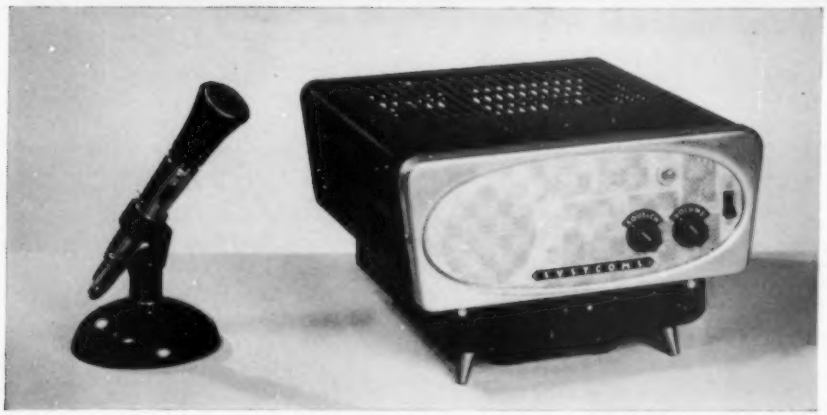

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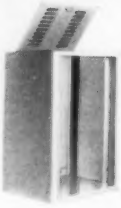

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with
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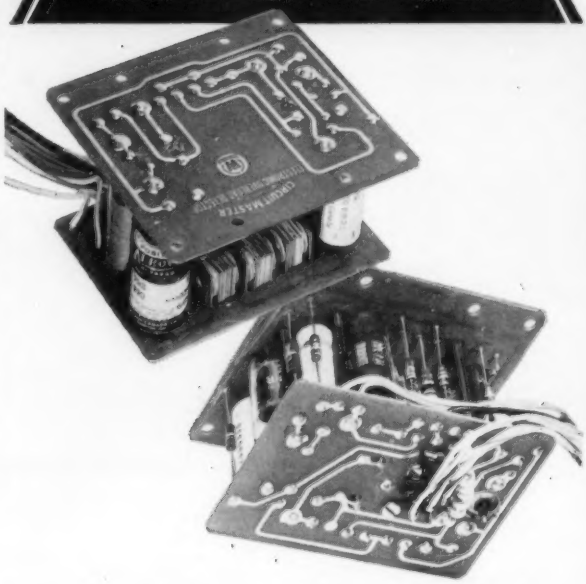

Printed Circuits Make It Possible

The parallel circuit construction of this electronic press control demonstrates the compactness which can be achieved with printed wiring boards. This electronic package is responsible for the automatic protection of expensive equipment and must perform reliably over a lengthy span of time under fluctuating operating conditions.

Printed Wiring Boards are available single or double sided, with solder or precious metal finish and eyeletted or with plated-through holes.

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For detailed information contact our Technical Representative

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231 Gage Avenue North, Hamilton, Ontario

Sales Offices: Hamilton, Toronto, Montreal

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New products at the show

TV picture tube 177

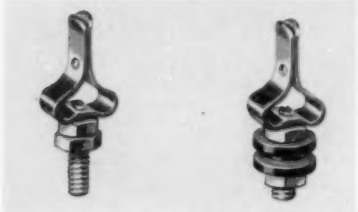
The new 23 inch Marconi-RVC picture tube enables set manufacturers to produce a slimmer tv set with a larger viewing area and greater brilliance. There is one exterior safety glass instead of the conventional three, making it easier to keep clean. The bulb has square corners giving a larger viewing area.
Canadian Marconi Company Booth 145

Electronic voltmeter 178

Bruel & Kjaer model 2409 electronic voltmeter is primarily designed for accurate and reliable voltage measurement in the frequency range 2 cps to 200,000 cps. The voltage ranges rate from 10 millivolts to 1,000 volts full scale deflection. It consists of a calibrated attenuator, a stabilized amplifier with cathode follower stages in the input and output circuit and a moving coil meter provided with special rectifier circuits for the measurement of peak, arithmetic average and true rms valves.
R-O-R Associates Ltd. Booth 261

Miniature test clips 179

Two miniature test clips introduced by Grayhill Inc., models 2-20 and 2-24, extend only ¾ inch above the mounting panel and are designed to allow rapid connections without manually opening and closing jaws. The clips are suitable



for testing resistors, capacitors, transistors, and other pigtail type components.
Lake Engineering Co. Ltd. Booth 436

Signal generator 180

Measurements model 560-FM standard signal generator is specifically designed to meet the requirements of the mobile communications industry for a multi-range, rugged, precision instrument for use in field or factory. It features direct reading individually calibrated frequency ranges from 25 to 960 mc; accurate frequency deviation meter; internal 1000 cps modulator and provision for external modulation from dc to 15 kc; fine frequency control permits shifting carrier 16 kc to facilitate discriminator alignment; calibrated mutual inductance attenuator; output continuously monitored by bolometer bridge.
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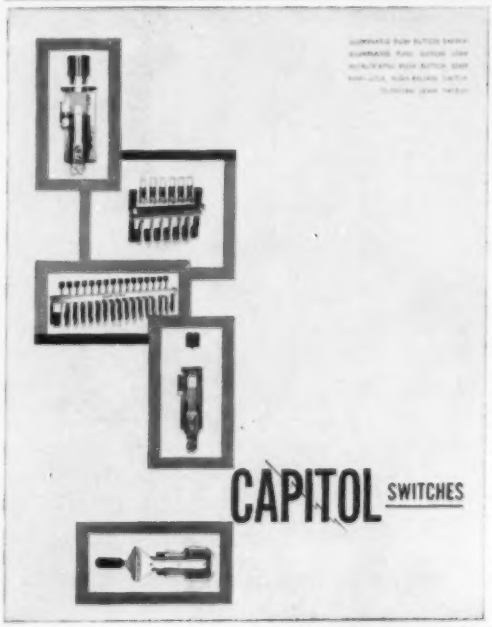

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Scale readings are read directly off the 3-range micromho scale (0-3,000; 6,000; 15,000) in both English and True Micromhos. The Tester uses rectifier current to energize both plates and grid. Provision is made for new tube designs. Provides vital life test. Noise test. Incorporates facilities for checking of CRT tube with adaptor.

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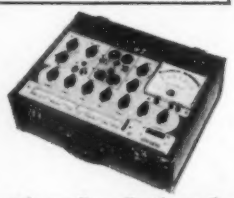

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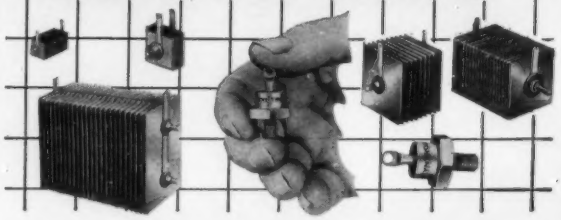

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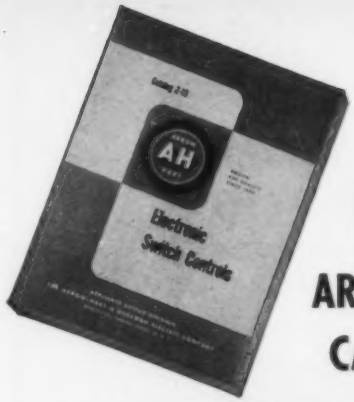

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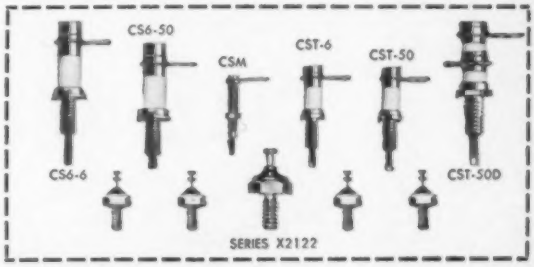

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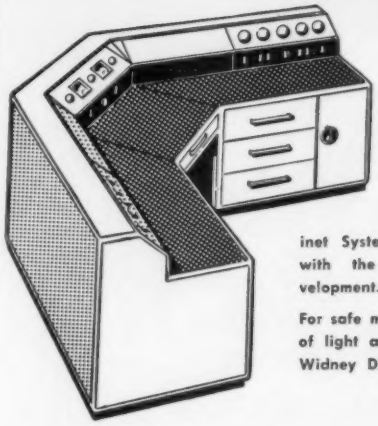

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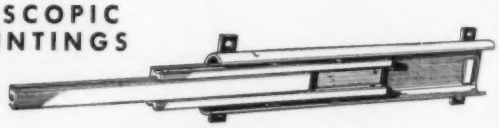

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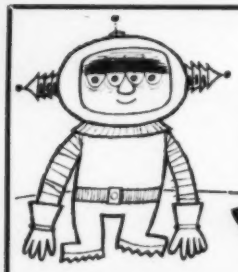

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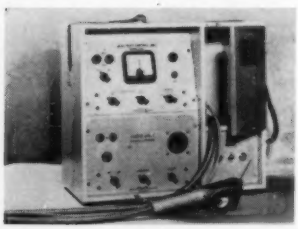

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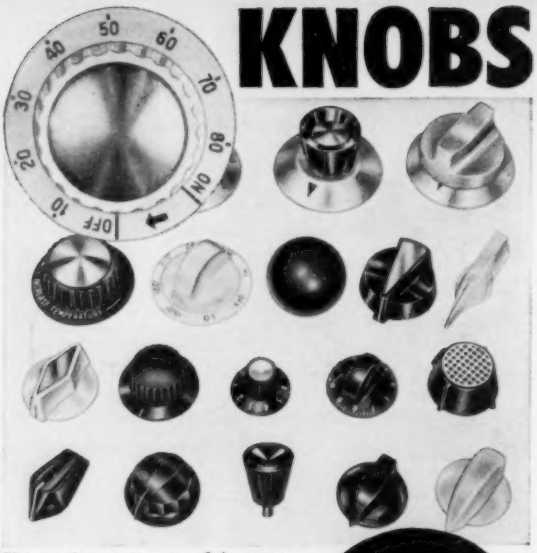

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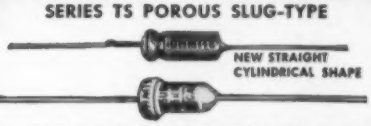

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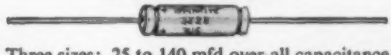

Three sizes: .25 to 140 mfd over-all capacitance range. Working voltages up to 150. Meet MIL-C-3965B. **BULLETIN 152**

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Business firms are not giving enough aid for education

Statistics released by the Industrial Foundation on Education show that only 2.8% of the tax-paying corporations in Canada gave financial aid to universities and colleges in Canada during 1958.

Last year's grants amounted to $10,400,000, down 10% from the 1957 total of $11,600,000.

Direct grants from companies remained at about the same level as in 1957, but grants from foundations established by industrial firms were much smaller.

It is significant that of the 2,523 companies contributing, 2,101, or 83.2%, were Canadian-controlled. However, U. S.-controlled companies gave 30.1% of the total grants.

Engineers' wives give two bursaries

Two bursaries, each valued at $500, were presented to two first-year engineering students by the Professional Engineers Wives Association.

The presentation was made by Association President Mrs. H. R. Fielding of Toronto to D. Ramsey of Islington, and U. Treiers of Niagara Falls. Ramsey has enrolled in civil and Treiers in electrical engineering at the University of Toronto.

Two new extension courses offered

University of Toronto is offering two new courses for its evening students this year. They are Nuclear Engineering, and Instrumental Methods of Analysis. Lectures begin this month and full information may be obtained from the Director, Division of University Extension, 65 St. George Street, Toronto 5, Ont. Telephone: WA. 3-6611, locals 304, 308, 526.

Dominion Electrohome presents scholarship

Norman John Kilian, a graduate of Eastwood Collegiate Institute in Kitchener, Ont., is this year's recipient of the Electrohome Electronics Education Award, valued at $1,600.

The award is granted for the study of radio physics, electrical engineering, engineering physics, or physics with electronics option at any Canadian university. Any graduate student of the Kitchener-Waterloo or Eastwood collegiates, intent on further study in these fields, is eligible to receive it.

Mr. Kilian will enroll this fall in the engineering physics course at the University of Toronto. In addition to the $1,600 which the student receives for tuition payments, Dominion Electrohome makes a donation of $500 to the university which the award winner chooses to attend.

C. A. Pollock, president of Dominion Electrohome Industries presenting N. J. Kilian with education award.

Industrial electronics course

Electro Sonic Supply Co., in cooperation with Canadian General Electric Co. Ltd., is providing a course in industrial electronics. It is designed to provide technicians with a better understanding of how electronic equipment works and is utilized in industry. Graduates of the eight-week course will be qualified to take an active part in the use, application and maintenance of this type of equipment. Sessions began September 15 at Toronto.

U. S. patents reach 2,900,000 mark

The Patent Office of the U. S. Department of Commerce issued patent number 2,900,000 in mid August. Recipient was an Englishman.

George Washington, in advising Congress in 1790 to pass the first Patent Act, pointed to the fact that foreigners should be encouraged to seek patents in the United States in order to bring to that country knowledge of inventions made abroad.

Patents are now being issued at the rate of about 1,000 each week and patent applications are being deposited in the Patent Office at the rate of approximately 350 each working day.

COMING EVENTS

October

5-7 Fifth National Communications Symposium, Utica, N.Y.

5-9 Eleventh annual convention and professional equipment exhibit of the Audio Engineering Society. Hotel New Yorker, N.Y.

7-9 IRE Canadian Convention, Exhibition Park, Toronto.

12-14 1959 International Systems Meeting of the Systems and Procedures Association of America, Toronto.

12-14 The 15th National Electronics Conference, Chicago.

20-21 Central Canada Broadcasters Assoc., Engineering Conference, Toronto.

28-31 Third annual stereophonic high fidelity exposition. Park Plaza Hotel, Toronto.

29-30 PGED 5 annual electron devices meeting, Washington, D.C.

November

9-11 EIA-IRE Radio Fall Meeting, Syracuse, N.Y.

10-12 Twelfth Annual Electrical Techniques in Medicine and Biology Conference. Philadelphia, Pa.

17-19 Northeast Electronics Research and Engineering Meeting. Boston, Mass.

25-28 International Radio Hobbies Exhibition. London, England.

Transistor power amplifier

In a previous article H. L. Armstrong discussed transistor amplifier stages of the low level type. Now he has prepared a paper dealing with power amplifier stages. It will be in the November issue of CEE.

Part 2 of the Harris and Parrott paper on natural environment will continue with atmospheric gases.

As soon as this issue goes to press, the editors of CEE will go into training for that marathon known as the IRE Canadian Convention. Their objective is to gather all the significant news for presentation next month.

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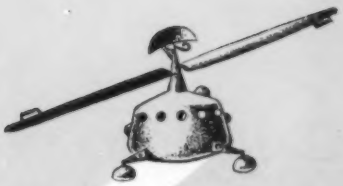

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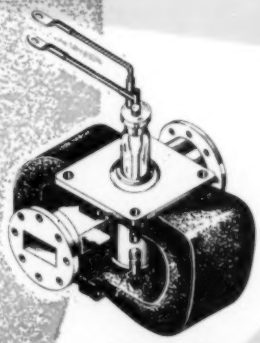

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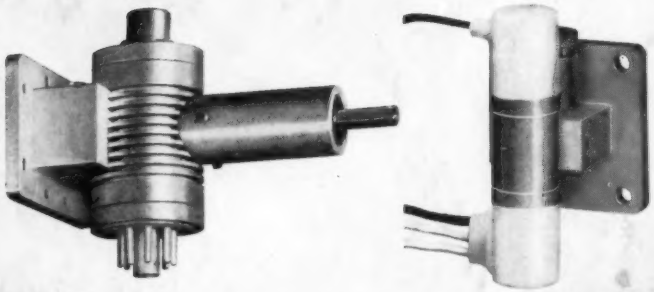

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